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Willys-Knight Production Methods

By Fred H. Colvin
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Special oil gear driven boring machine—Pressing in bearing bushings—Rotary milling of fly wheel end—Fixtures with rapid clamping devices reduce handling time

Crankcases

THE crankcase of the Willys-Knight engine is of aluminum, and is cast and machined by the Wilson Foundry & Machine Co., Pontiac, Mich. The design differs in the 4- and 6-cylinder engines, the 4-cylinder having a 3-bearing crankshaft while the crankshaft for the 6-cylinder engine has 7 bearings. There is also another difference in the way the bearings are located in the crankcase. In the 4-cylinder engine, the crankcase is divided at the center of the bearing while in the larger engine, the center line of the bearing is above the parting or face line. The difference can be seen in Figs. 1 and 2. The first is the crankcase for the 4-cylinder engine and the large milling cutters sweep the flat surface of the crankcase joint with the oil pan, including the arms by which the engine is supported in the frame. This shows one of a series of fixtures on the milling machine table.

In Fig. 2 is the end one of a string of 6-cylinder crankcases showing the cutters that mill the arms as well as the center cutters, projecting below the others, that cut the seats for the bearing caps. At the end of the crankcase is a fixed gage for setting the cutters. The different heights are properly located so that the operator is relieved of all measuring, merely setting the cutters to the finished surface on the gage, as *A*, *B* and *C*.

The milling is followed by an inspection after which the bottom is drilled and two of the holes reamed to be used as locating points for future operations. The top and ends are then drilled at one operation, as in Fig. 3, on a Fox 3-way multiple drilling machine having independent motors on each drilling head. The crankcase is located by means of the holes already mentioned and positioned horizontally by the two rails beneath. The clamps are arranged to be applied easily and quickly, so as to reduce handling time to a minimum.

After a number of counterboring, chamfering and tapping operations, the crankshaft and eccentric holes are rough bored. The latter are equivalent to the holes for the camshafts in poppet-valve engines, and are bored in the same way. The rough boring is done on the double-ended Fox machine shown in Fig. 4, the fixture shown being for the 6-cylinder engine. This view shows how the boring bars are supported between each of the bearings and how the hole for the generator shaft is bored in the end at the same setting. The clamping arms *A* and *B* are made as light as is consistent with strength and rigidity, and are easily handled. They are shown swung back out of the way. The long bolts hook into the jaws in front and allow rapid adjustment by means of handwheel nuts at the upper end. The air hose at *C* makes it easy for the operator to blow chips away from the locating points of the fixture while the fixed air-jets at each end clean the end guide-bushings ahead of the boring bars. Similar pipes with nozzles, fastened to the cover of the fixture, clean the inner guide bushings. This machine has an Oil-Gear drive.

The sides of the main bearings are faced by straddle mills that cut from the lower side. In other words, the crankcase is upside down over the cutters. The oil-slinger groove is milled, bearing stud holes are drilled, tapped and re-tapped to insure the desired fit, and the main-bearing studs and caps are assembled in the case. Then comes the boring of the bearing seats in both the crankcase and the caps, a detail of the fixture being shown in Fig. 5. This view shows the single-point cutters used, together with the openings in the bushings for the cutters to pass through; the overhead clamp *A* with its three bearing points; the piping *B* for carrying lubricant to the cutters; the dowels *C;* the locating clamps; and the latch *D* that hooks into the eye *E*, and holds the crankcase firmly in position while being bored.

Solid bushings are used for the bearings of the eccentric shaft. The bushings are pressed in under a

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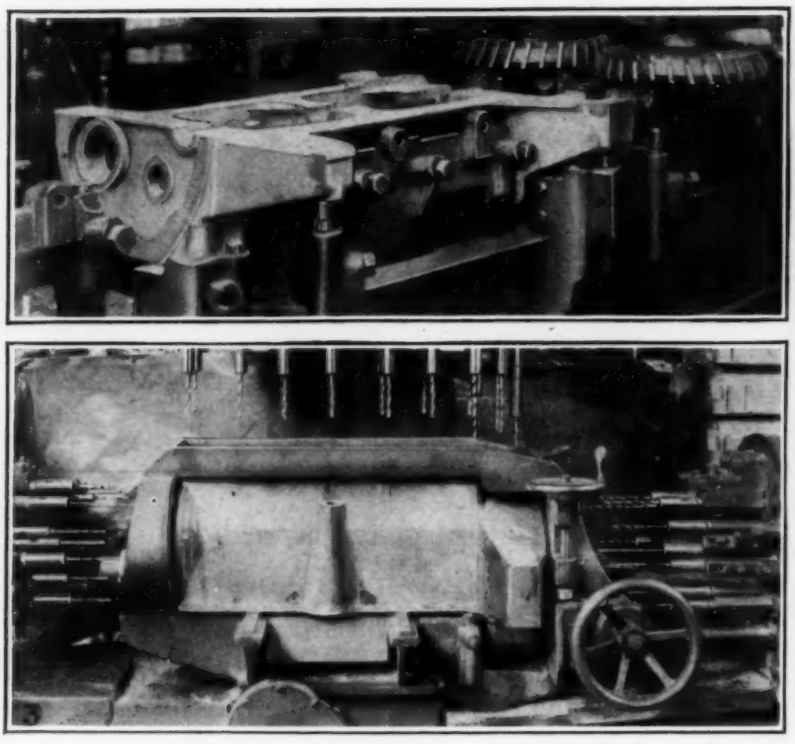

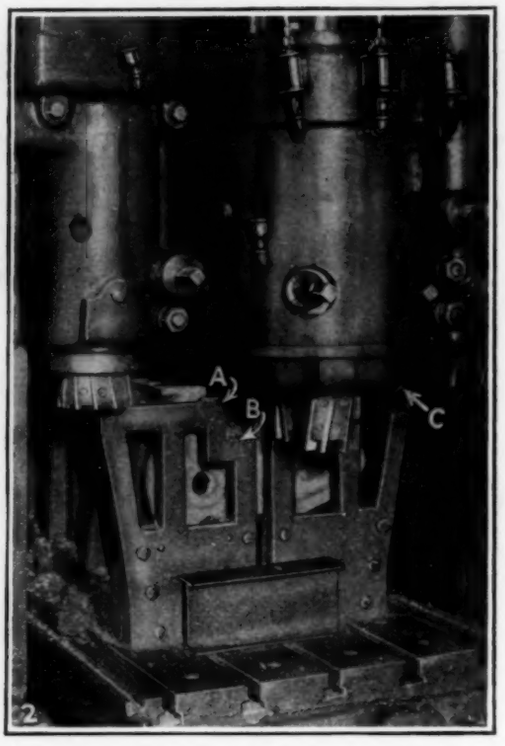

Fig. 1—Surfacing the lower face of crankcase. Fig. 2—Gages and cutters for 6-cylinder case Fig. 3—Drilling in 3-way machine

hand-operated press, Fig. 6. The mandrel *A* is an easy fit in the bushings, and is necked at suitable intervals. The C-washer *B* is provided, by which pressure can be applied to any bushing in the assembly. By slipping the washer into any groove the bushing below it can be forced into place. The bushings are first placed in position on the cross members of the crankcase, and one after the other readily forced into place, after slipping the washer into the proper groove.

The bell-housing end that receives the transmission unit is machined on the special Newton, rotary-head milling machine in Fig. 7. The operation is virtually

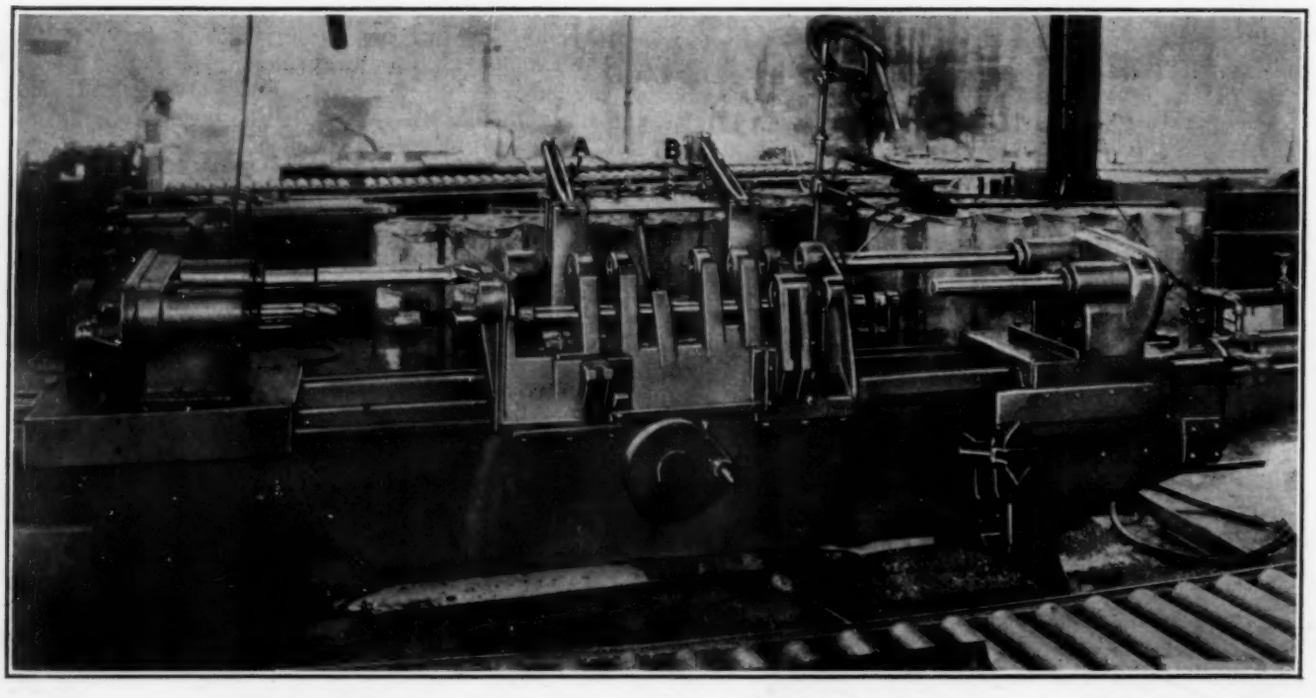

Fig. 4—Boring machine equipped with Oil-Gear drive

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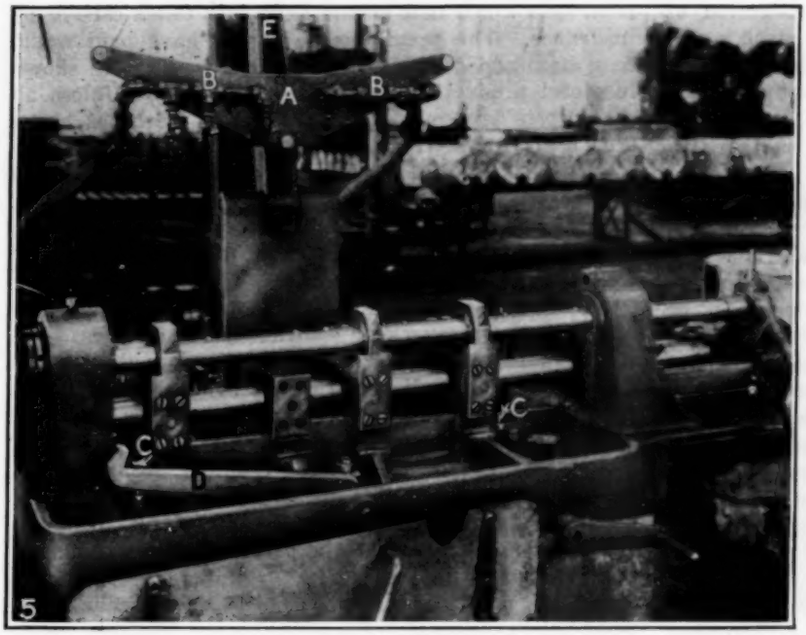


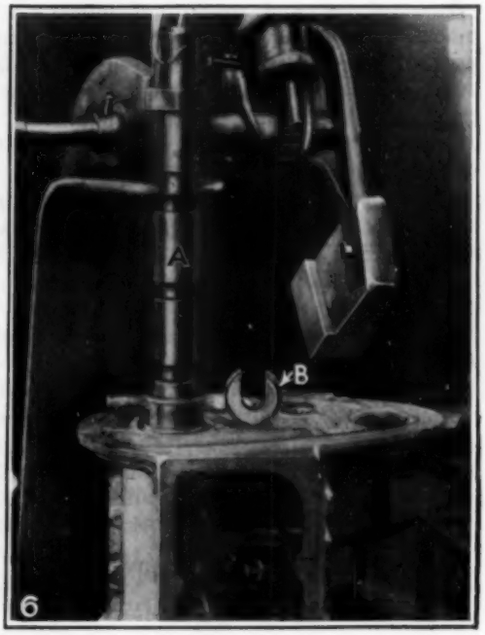


Fig. 5—Fixture for finish boring. Fig. 6—Pressing in bearing bushings

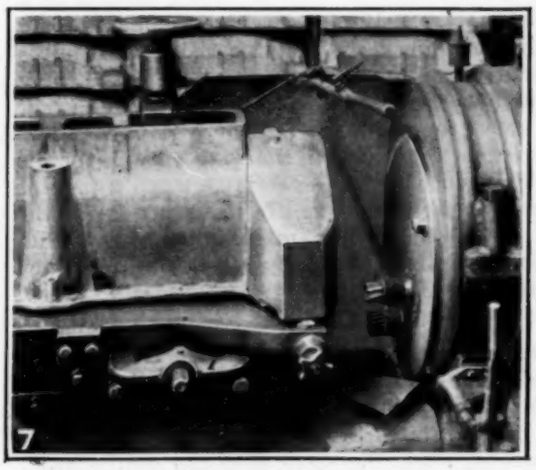
one of boring and facing and is one of the cases where milling has replaced the older methods of machining. The method of locating the crankcase on the dowels is shown as well as the overhead clamp.

There are many inspections to insure correct sizes, and alignment of bores and surfaces. A few of the gages are shown in Fig. 8. The gage *A*, at the left, checks the center distance of the crankshaft and eccentric shaft. This gage also checks the location of various holes around the flange.

The relation between the lower or oil pan surface of the crankcase and the end, is shown by the gage in position at *B*, while at *C* is a gage that checks the squareness of the end, the size of the bore and the location of the holes. The flywheel case *D*, is bolted in place before the boring and facing operation, Fig. 7, and is, of course, tested as a part of the crankcase itself. Conveyors have been in evidence in the various operations, and they play an important part in making possible the easy handling and in securing the desired production rate.

In some respects a crankcase is one of the most difficult parts of an automobile engine to handle efficiently, on account of its large size, thin walls and necessity of machining a variety of surfaces in proper relation to each other. The fixtures are, of necessity, large and bulky, and cannot be handled as easily or as quickly as with some other parts. The necessity of securing alignment between the camshaft, and camshaft bearings, and of having the bell housing square with the crankshaft, adds to the problems involved.

Although the design of crankcases varies widely with different engines, and while each design requires more or less special treatment, the methods by which the Willys-Knight crankcases are handled are full of suggestions for similar work in other than automotive shops.



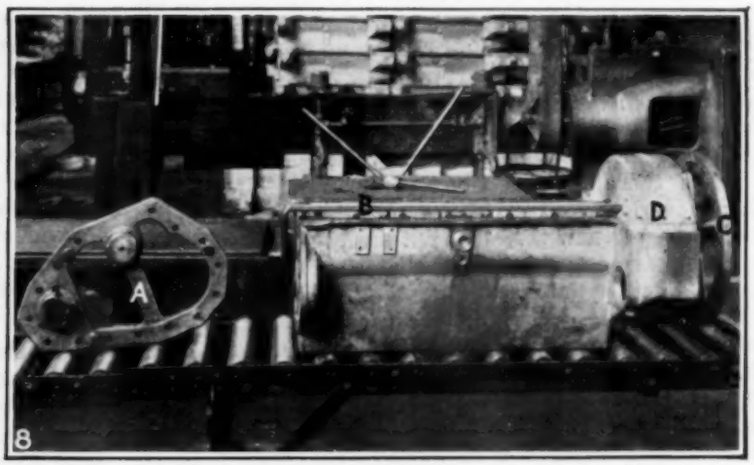


Fig. 7—Machining bell-housing end of case. Fig. 8—A few of the gages used

Machine Shop Fires and Insurance

THERE has long been a delusion that machine shops could not and would not burn. A collection of machines built almost entirely of iron and steel, a few wooden benches, perhaps, but with steel legs in nearly every case, and some belting, that is ruined by fire but that is not inflammable in the usual sense. The pattern storage is, of course, burnable—but what is there to burn in the machine shop?

This sort of reasoning has lulled many machine shop owners into fancied security and made it seem unnecessary to provide either modern fire protection or adequate insurance. Sprinkler heads are a great protection, of course, and ideal, perhaps, for the pattern storage or pattern shop. But why take a chance of having the sprinklers let go on a lot of valuable machinery and ruin it by rust? Water damage was usually worse than a fire, and there wasn't anything in the shop anyhow! And so, year after year, many a machine shop proprietor or manager has gone on, patting himself on the back for the "savings" he had made in fire insurance premiums and in fire extinguishing apparatus.

When the Fire Comes

Not very often it is true, but every once in a while, he wakes up to the fact that his machine shop that couldn't burn because there was nothing in it to maintain a fire, has gone up in smoke. He jumps into the nice new automobile he has bought with money saved on fire insurance premiums and rushes to the shop to find little besides a smoking ruin. The oil-soaked floors and bench tops have burned like tinder, the floor beams have gone and the roof trusses, even if of steel, have twisted and buckled in the intense heat from below and dropped into the ruin. The machinery of iron and steel that could not burn, has been heated in some places more than others, and then suddenly cooled by the streams which the firemen used in vain to extinguish the flames.

Instead of having machinery that was rusted in places from the flooding due to sprinkler heads that let go as soon as a fire starts, he has machines that are so warped and twisted due to the uneven heating and the sudden cooling, as to be fit only for the cupola in most cases. Certainly few tools that have gone through such an ordeal of fire and water, of falling floors and roof trusses, can be put into condition to again build the accurate products of which they are capable.

No matter if the building is of stone or concrete and steel, fire does get a start and plays havoc in short order. Sprinkler heads are pronounced the safest form of protection, this being backed up by substantial reduction of premiums by insurance companies.

Then there are questions of insurance itself that many overlook, except in a very general way. When the factory is new they take out an insurance policy for an arbitrary amount, but rarely consider, as the years go by, whether the insurance would replace the building at present costs. Insurance on the contents of the building, not only of the machine equipment but of the goods in process, receive even less attention in most cases. Yet if insurance is not carried that will cover the true and full value of both equipment and the products that are in various stages of completion, the owner is carrying a risk that he is not counting as one of his costs of production. For, when and if the fire does come, he must bear a loss that should have been taken care of by insurance. The premiums he should have paid would have been added in his overhead and would have shown his total production cost in its true light. Unless all these costs are counted, no builder of machines has a true basis for setting his selling prices.

There is also another phase of insurance too often overlooked, known as "Use and Occupancy" insurance. This covers the loss of profit and overhead that occurs during the time necessary to get the business under way again after a fire. And this is frequently a very considerable item which might be sufficient to seriously handicap the recovery or continuance of business of a small company. For, even should it be possible to find another shop immediately, there is bound to be delay in getting production started. There are tools, fixtures, and gages to be made, even if the patterns were not destroyed. The insurance for "Use and Occupancy" is a very real item and, like insurance on work in process, is apt to be overlooked in counting costs, unless there is the insurance premium to be paid and recorded among the items of overhead.

A large number of men do not seem to realize just what the "Coinsurance Clause" means. Where a property is under-insured this clause has a serious effect on the insurance that will be secured. Where a property is only insured to half its present value the 80 per cent clause only gives about $\frac{5}{8}$ of the loss incurred. It is only when the loss exceeds 80 per cent of the sound value that the full insurance can be collected.

Where one deliberately under-insures his property he should pay a higher rate and get the partial coverage policy. If he feels that he prefers the lower rate of the "coinsurance clause" he should insure up to the contract limit and get real coverage.

If a man under-insures he should realize that he is taking the risk himself and be prepared to meet it. Insurance contracts are recognized by the courts and it doesn't help at all to plead ignorance of what the contract really means. It is much better to know in advance just what a policy covers before the fire occurs. A competent appraisal is the best means of knowing how much insurance a plant should carry.

A so-called fire-proof plant is to be desired in all cases, but fires occur even here at times, though of a less serious nature. If the machine builder cannot afford such a building he is taking a risk that requires a larger margin of profit than is usually obtained in the machine business. If the machine builder feels that he cannot carry the necessary insurance to protect him against emergencies, he is not charging enough for his product. For adequate insurance is as much a part of legitimate business expense as life insurance is for the individual. And unless the machine builder carries both, he is jeopardizing not only his business but the future welfare of his family.

The absence of one or two injured men from a small shop make a big hole in the output. For that reason it pays to guard against accidents of all kinds. If it pays the United States Steel Co. to spend millions to keep its men at work, the small shop can well afford a small investment in guards, goggles and first-aid kits.

The Design of Gear Tooth Forms

By Earle Buckingham
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Action of an involute against a straight line—Summary of involute curve properties—Its application to gear tooth profiles—Duration of contact

WHEN an involute acts against a straight line, we have the conditions shown in Fig. 22. The straight line is tangent to the involute and is always perpendicular to its line of action. When it is constrained to move only in the direction of the line of action, it will be moved at a corresponding and uniform rate, if the involute is revolved at a uniform rate. The distance this line moves depends upon the size of the base circle of the involute. Thus, for one complete

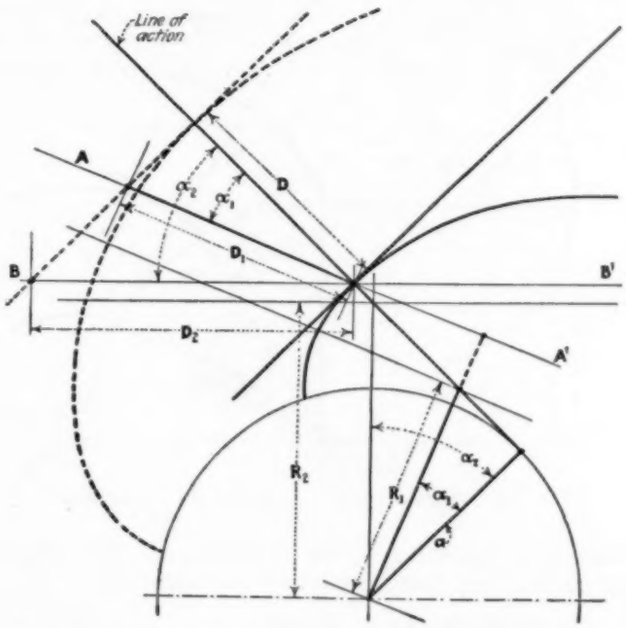

Fig. 22—Action of an involute against a straight line

revolution of the involute, the line will move along the line of action a distance equal to the circumference of the base circle.

We will now consider the motion of this straight line when it is constrained so that it can move only in the direction of the line AA'. If we designate the distance which the line travels along the line AA' as D_1, the distance the line has moved along the line of action as D, and the angle between the line of action and the line AA' as α_1, we have the following relationship:

$$D_1 = \frac{D}{\cos \alpha_1}$$

As the value of D changes uniformly, and since the value of α_1, is constant, the value of D_1 changes uniformly. As $\cos \alpha_1$ can never be greater than unity, the value of D_1 will never be smalled than D. Therefore, when the line against which the involute acts is constrained so that it moves only in the direction of the line AA', the distance it travels along this line will be greater than the distance along the line of action, but its rate of motion will be uniform as long as the rate of rotation of the involute is uniform.

If the involute should make one complete revolution, the value of D would become $2\pi a$. The value of D_1 would then be $2\pi a/\cos \alpha_1$. This also represents the circumference of a pitch disk which runs with a straight edge parallel to the line AA'. The radius of this pitch circle thus becomes equal to $a/\cos \alpha_1$. In Fig. 22 the radius of this pitch circle is designated by R_1 and it is established by the intersection of the line of action with a radial line of the base circle which is perpendicular to the line AA'.

In like manner, when the line, against which the involute is acting, is constrained so that it moves only in the direction of the line BB', the distance R_2 becomes the radius of the pitch circle of the involute and the angle α_2 becomes its pressure angle. The motion along the line BB' is also uniform when the rate of rotation of the involute is uniform. The distance D_2 equals $D/\cos \alpha_2$, and R_2 equals $a/\cos \alpha_2$.

Summary of Involute Curve Properties

It follows, then, that the involute curve has the following properties:

1. The shape of the involute is dependent only upon the size of the base circle.
2. If one involute, rotating at a uniform rate of motion, acts against another involute, it will transmit a uniform angular motion to the second, regardless of the distance between the centers of the two base circles.
3. The rate of motion transmitted from one involute to another depends only upon the relative sizes of the base circles of the two involutes. This rate of angular motion is in inverse proportion to the sizes of the two base circles.
4. The common tangent to the two base circles is the line of action. In other words, the two involutes will make contact with each other only along this common tangent of the two base circles.
5. The line of action of an involute is a straight line. Any point on this straight line may therefore be taken as a pitch point, and the line of action will remain symmetrical in regard to it.
6. The intersection of the common tangent to the two base circles with their common centerline establishes the pitch lines of mating involutes. No involute has a pitch line until it is brought into contact with another involute or a straight line constrained to move in a definite fixed direction.
7. The pitch diameters of two involutes acting together are directly proportional to the diameters of their base circles.
8. The pressure angle of two involutes acting together is the angle between the common tangent to the two base

The fifth article. The sixth will appear in an early issue.

circles and a line perpendicular to their common center-line. No involute has a pressure angle until it is brought in contact with another involute or a straight line constrained to move in a fixed direction.

9. The pressure angle of an involute acting against a straight line constrained to move in a fixed direction is the angle between the line of action and a line representing the direction in which the straight line can move.

10. The pitch radius of an involute acting against a straight line constrained to move in a fixed direction is the length of a radial line, perpendicular to the direction in which the straight line can move, measured from the center of the base circle to its intersection with the line of action.

Use of the Involute Form for Gear Tooth Profiles

When the involute form is used as a gear tooth profile, several involute curves are developed from the same base circle to form the profiles of the several teeth. As the gear tooth profile is symmetrical, for the present we shall consider but one side of the teeth.

In Fig. 23 is shown the development of one side of the several teeth. Imagine a string with knots equally spaced wound about the circumference of the base circle. As this string is unwound, each knot will describe an involute curve. The distance between these involute curves, measured along any line tangent to the base circle, is always the same. This distance is equal to the length of the arc of the base circle between the origins of two successive involutes, and is the *normal pitch* of the gear.

Thus when Pn = normal pitch
a = radius of base circle
N = number of teeth in gear.

$$Pn = \frac{2\pi a}{N} \qquad (19)$$

In a pair of mating gears the normal pitch must be identical in order to secure smooth, continuous action.

Duration of Contact

One of the important factors in the design of gears which are to transmit power is that the involute profiles must be so selected that the second pair of mating teeth will be in contact before the first pair are out of contact. The proper amount of contact depends upon several conditions. If the form of the tooth is rugged, and the load, when applied towards the outer end of the tooth, causes practically no deflection, the amount of overlap may be small with satisfactory results.

The angle of action is the angle through which one tooth travels from the time it first makes contact with its mating tooth until it ceases to be in contact. The number of teeth in contact, or the contact ratio, is the quotient of the angle of contact divided by the angle between two successive teeth on the gear. Thus if an overlap of 0.6 exists, the number of teeth in contact is 1.6.

In Fig. 24, that part of the line of action which is intercepted by the two outside circles of a pair of mating gears, shown as a heavy line, is the length of the arc of the angle of action measured at the radius of the base circle. This length divided by the normal pitch, which is the length of an arc of the base circle between two successive teeth on the gear, gives the number of teeth in contact.

The angle of action is often divided into the angle of approach and the angle of recess. The angle of approach is the angle through which the tooth moves from the time it first comes into contact with its mating tooth until contact is made at the pitch point. The angle of recess is the angle through which the tooth moves from the time when the contact is at the pitch point until it ceases to be in contact with its mating tooth.

Referring to Fig. 24, let

a = pressure angle
ω_1 = angle of approach
ω_2 = angle of recess
N_1 = number of teeth in pinion
N_2 = number of teeth in gear
C = center distance
R_1 = radius of pitch circle of pinion
R_2 = radius of pitch circle of gear
E_1 = radius of addendum circle of pinion
E_2 = radius of addendum circle of gear
Pn = normal pitch.

Simple formulas can be derived for the values of ω_1 and ω_2 and the number of teeth in contact by solving several right triangles. The angle of approach ω_1, in circular measure, is found by dividing the length of the

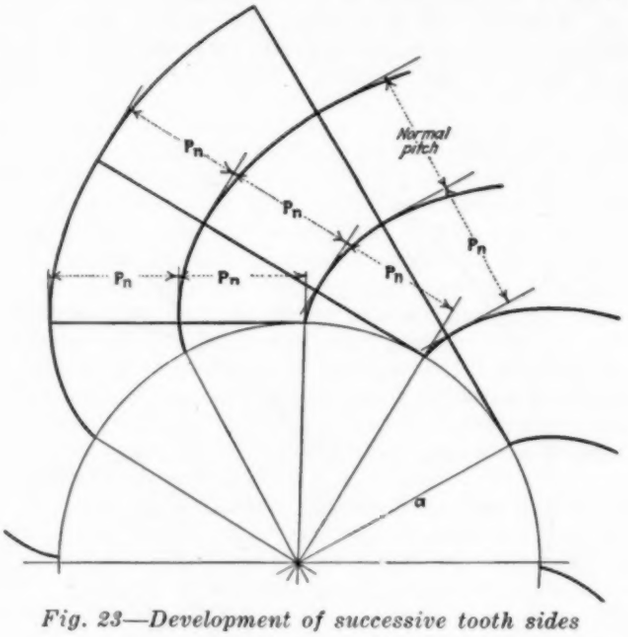

Fig. 23—Development of successive tooth sides

line yv by the radius of the base circle a_1. This length is equal to the length xv minus the length xy.

Length of line $xy = R_2 \sin a$

Length of line $xv = \sqrt{(E_2)^2 - (a_2)^2}$

Whence $$\omega_1 = \frac{\sqrt{(E_2)^2 - (a_2)^2} - R_2 \sin a}{a_1} \qquad (20)$$

The angle of recess ω_2 is found in a similar manner by dividing the length of the line yz by a_1. This length is equal to the length zu minus the length yu.

Length of line $yu = R_1 \sin a$

Length of line $zu = \sqrt{(E_1)^2 - (a_1)^2}$

$$\omega_2 = \frac{\sqrt{(E_1)^2 - (a_1)^2} - R_1 \sin a}{a_1} \qquad (21)$$

The number of teeth in contact is found by dividing the length of the line zv by the normal pitch Pn. The length of the line zv is equal to the sum of yz and yv.

$$zv = \sqrt{(E_2)^2 - (a_2)^2} + \sqrt{(E_1)^2 - (a_1)^2} - (R_1 + R_2) \sin \alpha$$

But $$R_1 + R_2 = C$$

whence, number of teeth in contact =

$$\frac{\sqrt{(E_1)^2 - (a_1)^2} + \sqrt{(E_2)^2 - (a_2)^2} - C \sin \alpha}{Pn} \quad (22)$$

Sometimes the tooth form of a gear extends below the base circle. No involute action, however, can take place below the base circle. Thus if the value of $\sqrt{(E_1)^2 - (a_1)^2}$ or $\sqrt{(E_2)^2 - (a_2)^2}$ is greater than $C \sin \alpha$, the total length of the line of action, the value of $C \sin \alpha$ must be substituted in place of the greater value because the line of actual contact cannot extend beyond the point of tangency to either base circle.

Active Profile

The active profile of a gear tooth is that portion of the tooth profile which actually comes in contact with its mating tooth along the line of action. In general, when the tooth design is such that excessive sliding exists, one or both active profiles will be short in proportion to the length of the whole tooth profile. When the amount of sliding is small, on the other hand, the active profiles will include most of the total tooth profile.

The extent of the active profile can be calculated by solving right triangles. Referring again to Fig. 24,

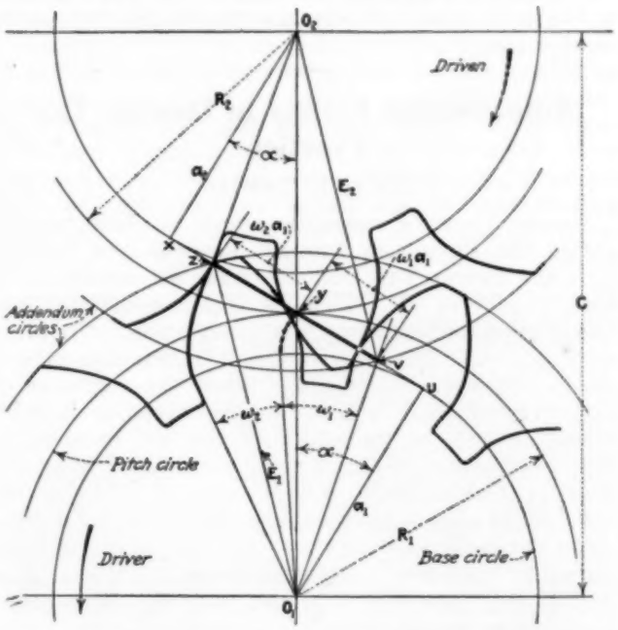

Fig. 24—Arc and angle of action with involute profiles

the active profile of the pinion is equal to the difference in length between the outside radius of the pinion E_1 and the radial line o_1v. The line o_1v is the hypotenuse of a right triangle of which a_1 and the line uv are legs.

$$\text{Line } uv = C \sin \alpha - \sqrt{E_2^2 - a_2^2}$$

Whence, active profile of pinion =

$$\sqrt{a_1^2 + [C \sin \alpha - \sqrt{E_2^2 - a_2^2}]^2} \quad (23)$$

Active profile of gear =

$$\sqrt{a_2^2 + [C \sin \alpha - \sqrt{E_1^2 - a_1^2}]^2} \quad (24)$$

(To be continued)

Secondary Operations on Parts Produced by the Automatic Screw Machine

By H. Applegard
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THE question of deciding which end of threaded or turned parts should be finished on the automatic machine is one that depends to a large extent upon practical experience for its solution, for there are many factors to be considered. This article will indicate the main principles and may serve to give the reader some useful hints.

Do the longest, most difficult and most expensive operations on the automatic, and do as many of them as

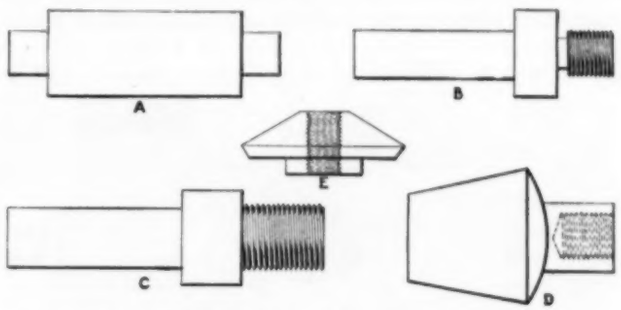


Fig. 1—Examples of repetition work

possible. In other words cut down the cost of finishing operations on the hand machine as much as is practicable. Where there is likely to be excessive breakage of tools, as in tapping, drilling small holes, etc., the parts should be finished on the hand machine.

In cases where accuracy within fine limits is essential, as in reaming or forming, it is good policy to arrange for a secondary operation and thereby speed up production on the automatic machine.

Let us take for example a part that is, perhaps, one of the most simple forms of double operation; the distance pillar shown at *A* in Fig. 1. As a rule, fine limits are not required on a part of this character, so in most cases it can be finished on the automatic. The exceptions are, when the diameters of the reduced ends are so small that the part breaks off while being formed, and when the tolerance is held within 0.002 in. on the diameter.

In cases where the length of a formed part is more than twice its diameter, it is advisable to leave the finishing to a secondary operation. On a job like that shown at *B* it is always good policy to finish the threaded end in the automatic machine, unless the diameter at that point is less than one-third of the diameter of the rod, in which case the part would probably break off in the finishing operation.

There are occasions however, when even alternative methods of manufacture do not overcome the difficulty, the brass dial-peg shown at *C* being an example of this kind. In this case it was not practicable to form the plain end on the automatic, because the diameter was so small that the part would break off in the forming operation. It was decided to turn the plain end on the automatic and to turn and thread the opposite end on the hand machine. Difficulty was again experienced, as the threading die caused many of the parts to twist off.

With the customer's permission a finer thread was substituted, and but little further trouble was encountered.

So far, examples have been given upon which the most expensive operations (compared to hand machine costs) were done on the automatic. There is another class, however, where the difficulty of chucking for a second operation makes it necessary to adopt other methods. Such an example is shown at *D*, where, owing to the steep angle of the taper, it was found advisable to do the drilling and tapping on the hand machine.

On the piece shown at *E* it was found necessary to do the tapping on the automatic. This piece, made of steel, could have been tapped much more cheaply on a separate machine but for the difficulty of holding it without risk of damaging the sharp edge at the periphery. The slow method of tapping on the automatic was therefore adopted.

There are cases where, owing to the trouble experienced in gripping the part true in a secondary operation, it is advisable to cam up the automatic so that the part may be finished on that machine. An example is shown at *F*, Fig. 2, which was tapped on the automatic for this reason.

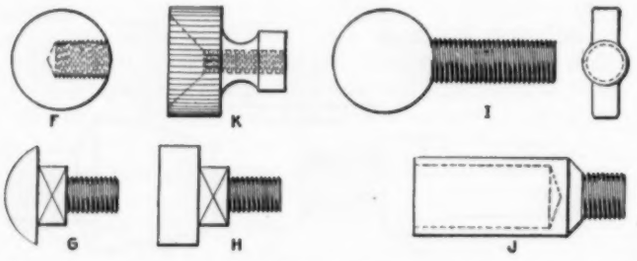


Fig. 2—Secondary operations are sometimes necessary

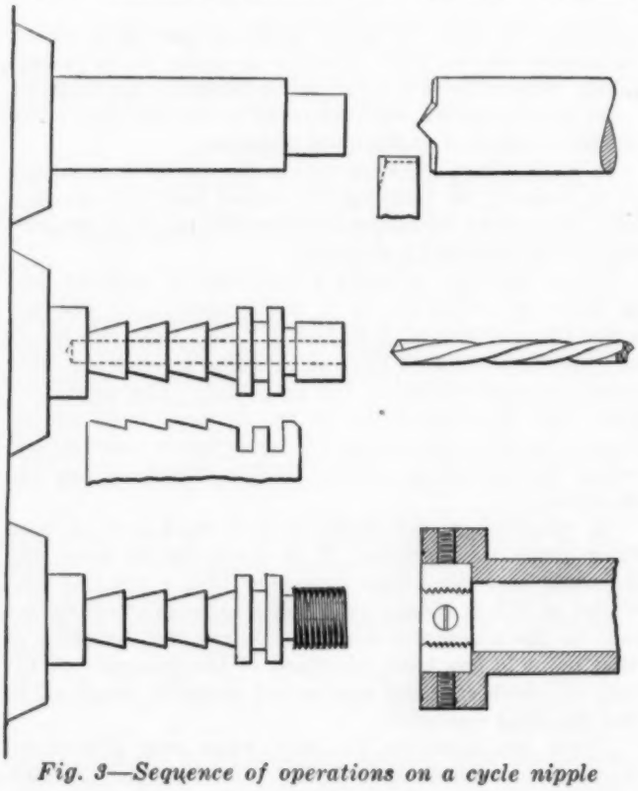


Fig. 3—Sequence of operations on a cycle nipple

In another case the difficulty of rechucking caused a change to be made in the design, as in the example shown at *G*. In this case, so much trouble was experienced in gripping the head truly and firmly while the shoulder was being milled, that it was necessary to make the piece as at *H*, rounding off the head after the shank was milled.

In the case of the steel thumbscrew shown at *I*, the milling operation caused many of the parts to break off. To overcome the difficulty, and at the same time reduce the cost of production, the parts were finally made from a smaller size of material and the two flats were produced in the punching machine, which brought the diameter up to the size required. It was necessary to anneal the parts before the squeezing operation was performed.

When the brass parts *J* were drilled on the automatic, it was found that in chucking them for the second operation in the hand machine, many were squeezed out of truth. Owing to the thread being short, it was not satisfactory to drill them on the hand machine. The difficulty was eventually overcome by having a stop with a projecting pin to fill the hole and thus prevent damage to the drilled end.

The knurled nut *K* was finished on the automatic, except for tapping. The small diameter did not need to be made to close limits, hence the piece was formed and the recessing done from the turret.

The operations on the cycle nipple shown in Fig. 3 were arranged in the order shown so that it could be completed on the automatic machine. The drilling operation was too long to be done at one station, so a short cam was adjusted to withdraw the drill after it had entered about half-way, and the drilling finished by another cam.

Amortization Claims in Income Tax Practice

By L. L. Thwing

Senator Couzen's committee which has been investigating the Bureau of Internal Revenue and particularly the Income Tax Unit has made its report—or at least a part of it. It claims that amortization has been "improperly allowed" in many cases. "Improperly" is a mild sort of a word and in this case reflects only a difference in opinion between the engineers of the committee and those of the Amortization Section. Whatever may be the effect on the tax situation in other industries it seems very improbable that the machine tool industry will be affected. Taking the industry as a whole it is probable that it did not receive amortization enough to cover the losses of war-time expansion, so unless a situation develops which is more radical than any now indicated, machine tool builders need feel no uneasiness.

There is a possibility that congress may authorize the reopening of all cases involving an allowance of over $500,000, but even in that case the situation of the machine tool builders is so strong in reference to post-war activitiy that any further investigation is more likely to indicate an additional allowance than any subtraction. The only possible point of interest in this connection is the alleged "impropriety" of allowing amortization on both the basis of lack of use and excessive cost. There is an unquestioned deduction of about 15 per cent of cost which might have been taken on all machinery. This deduction was not taken by machine tool builders generally but unless the recent decision of the Solicitor's office is upset, it would be possible to secure it by a more detailed presentation.

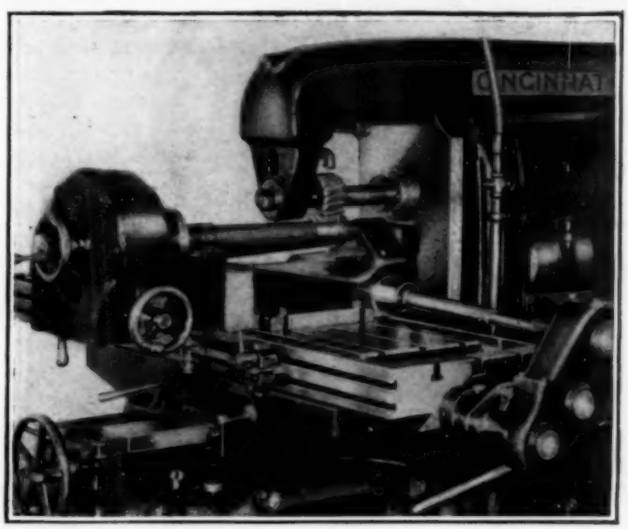
Wider Use of Milling Machines in the Railroad Shop

Detailed study of the milling of locomotive taper pins and keys on a production basis—Heavy cuts and fast speeds possible with modern equipment

THE trend of modern practice in railroad repair work is increasingly toward mass-production methods in the manufacture of small parts that must be frequently replaced. This trend is the result of detailed studies of shop cost which reveal the great savings that are available through tooling up to handle specific jobs in quantity instead of treating each part as a special problem. Few shops have enough work on a single part to warrant the use of the special equipment necessary to produce this part in quantity, but many railroads are following the general practice of having many of their small parts machined at one central place and afterwards shipped to the various shops for final fitting.

An attempt will be made to describe some examples of milling machines used to produce two common parts of a locomotive which are used in some degree of quantity; namely, taper pins and taper keys. The illustrations are taken from actual jobs performed in a progressive railroad shop whose executives had the foresight to purchase and install modern machine-tool equipment. By replacing obsolete equipment, the time necessary to complete these parts was considerably reduced. Perhaps the psychology of the worker and the new tool were partly responsible for this cost reduction.

The milling operations on a locomotive taper pin are shown in Figs. 1, 2 and 3. This piece is a steel forging containing 0.40 per cent carbon. The first step is to mill



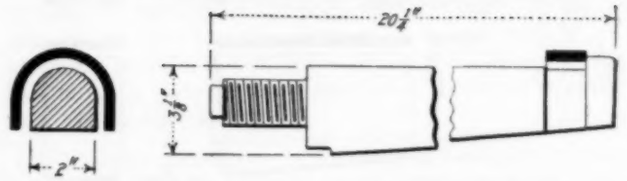


Fig. 1—Milling the back of a taper-pin head

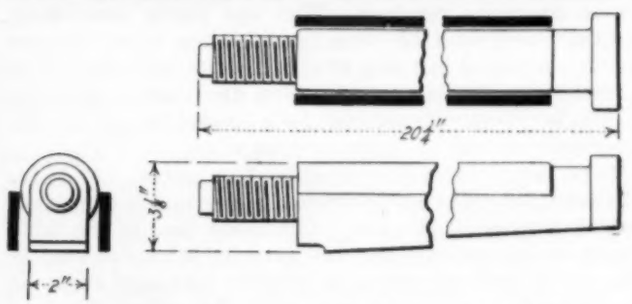


Fig. 2—Straddle milling of taper-pin sides

the back of the head and the flat and semicircular sides immediately adjacent to it. The set-up is indicated in the photograph, Fig. 1, and in the drawing below it the heavy black lines show the amount of metal removed. The pin is held between centers, one of which is a special power-driven fixture used when the circular milling is performed. A dog drives the work and is fork-shaped so that it can straddle the rough side of the work. The fork also serves to locate the flat sides of the piece with respect to the face of the circular milling fixture for proper indexing. The cutter itself, as can be seen, is mounted on a shortened arbor which receives additional

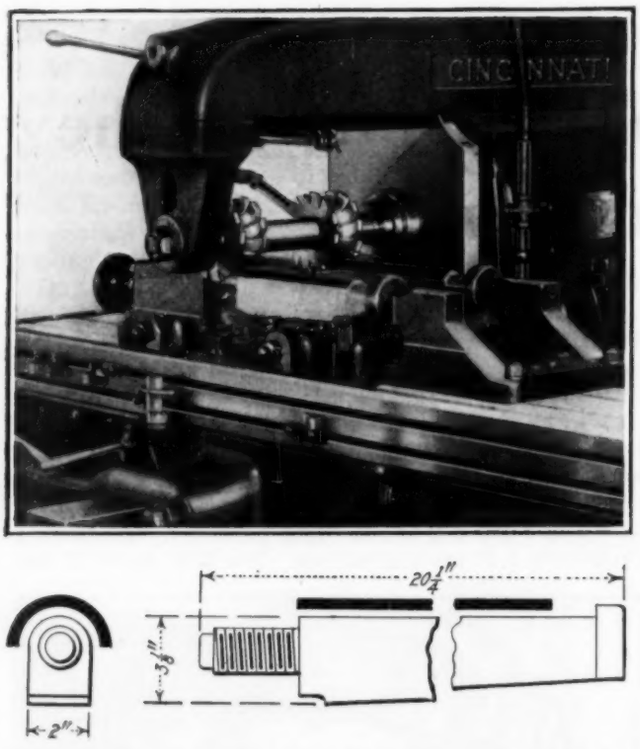


Fig. 3—Form milling of the radius on taper-pin length

support from the rectangular overarm of the machine.

The work is first set in the fixture and is then rapidly traversed forward to the milling position, when the table is automatically tripped down to the feed rate. After one straight side or flat has been finished the power feed is again automatically tripped out and the table is advanced by hand for about ⅛ in. until a fixed stop on the table strikes a stop block mounted on the saddle. The circular cutting fixture is now engaged and the work is revolved under the cutter for 180 deg. When straight milling and also when returning, a pair of trip-out dogs prevent the circular cutting fixture from otherwise rotating. With the radius completely milled, the fixed table stop is pulled out and the table feed is engaged to finish the cut on the other flat. The completed piece is removed from the centers and the table is rapidly traversed back under power to its original position to receive a new piece.

The complete cycle consumes 3 minutes. A 5½-in. diameter, special rounded-corner, spiral mill is employed, which rotates at 52 r.p.m. The linear feed of the table is 4½ in. per minute and the average stock removed is ⅛ in. A copious supply of cooling lubricant must be maintained. Note the pipe over the cutter for this purpose, Fig. 1.

The second operation of straddle milling the sides of the taper pin is performed in the same machine as for the first operation, as also are all the operations treated in this article. This milling machine may be recognized as the plain horizontal type.

As before, the work is held on centers which are also special fixtures; in this case, however, two pieces are finished at once. Special forked, hinge supports are incorporated in these fixtures so that the work is squared up from the flats previously milled in back of the head. Note the sturdy construction of the center supports at the right end which take the end thrust from the cutters.

The feed is 4½ in. per minute and the cutters rotate at 32 r.p.m. Four of the latter are used, each 9½ in. in diameter and of the inserted blade type. They are mounted on a 2-in. diameter arbor. On account of the long spindle and the heavy cut taken, ⅛ in., supports are used for the overarm to prevent chatter. The total time for two pieces is 5 minutes. A liberal supply of coolant is provided to maintain this high rate of production.

The final milling operation on this taper pin is to form the radius on one side for the full length. The forming of this radius directly behind the head of the pin was accomplished in the first operation, the result of which can be plainly seen in Fig. 3, which illustrates the third operation. The piece is again held on centers and, in fact, in the same fixture as was used in straddle milling the flat sides, Fig. 2. In this case no outer overarm supports are necessary. The cut taken is ⅛ in. as in all previous operations.

Two 6½-in. diameter, special concave-form cutters are mounted on a 1½-in. diameter arbor and are rotated at 32 r.p.m. The feed is 4½ in. per minute. The total time for two pins is 4.7 minutes. Note the large pipe for coolant in Fig. 3.

Two milling operations on a forged-steel taper key, common in railroad work, are illustrated in Figs. 4 and 5. The former shows the finishing of the length of the taper side. Previous to this operation the two parallel sides and the bottom flat were surfaced, so that three keys may now be clamped together with two all-steel vises, as may be easily seen in the photographs. The bottom flat of each key rests on a special taper plate, mounted on the machine table, which brings the surface to be milled to a horizontal position. The cutting is done with a 4½-in. diameter spiral mill mounted on a short, standard arbor which obviates the necessity of any additional support aside from the overarm. The cut is started at the large end of the taper and the

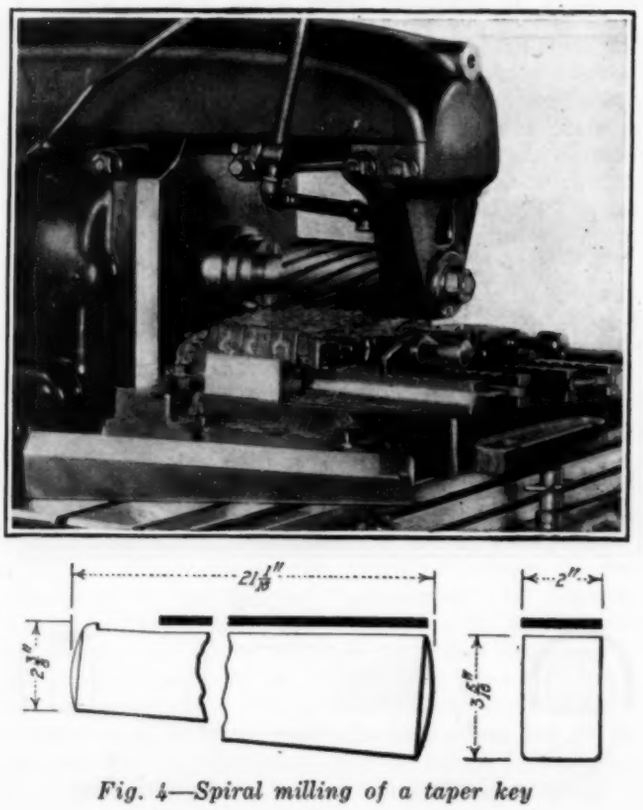


Fig. 4—Spiral milling of a taper key

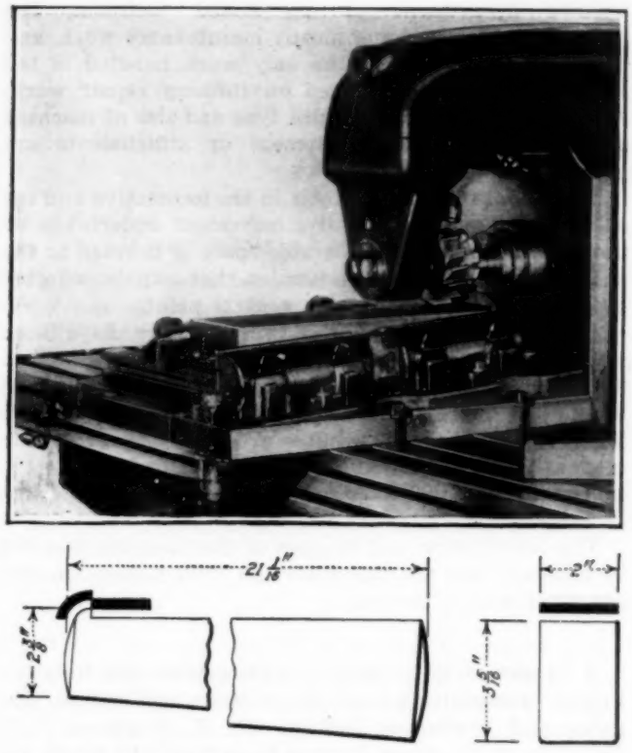


Fig. 5—Form milling of the lip on a taper-key head

work is fed toward the head but not entirely up to it. The radius left under the head is removed in the following operation:

The cutter rotates at 65 r.p.m. and the feed, as usual, is 4½ in. per minute. The total time for three pieces is 7.5 minutes. In order to take a cut of ⅞ in. the cooling must be quite positive.

For the final finishing of the end of the taper under the head and the forming of the lip on the head itself, the same taper plate and all-steel vises are used as in the first operation, except that the fixture is now set at a right angle to the position it formerly occupied on the machine table. Three taper keys are clamped side by side and are located endwise by a fixed angle block (not shown). Two cutters are mounted together on the arbor, one being a straight-faced cutter, 1½ in. wide, the other a special form cutter for the lip. Both cutters are 5½ in. in diameter and rotate at 52 r.p.m. The feed is again 4½ in. per minute and the cut is ⅞ in. deep. The total time for three pieces is 2.7 minutes.

In every case it is to be noted that the combination of speed, feed and cut is severe, but two factors make successful operation possible. The first is the rugged construction of the machine itself in the mounting of the cutter arbor and its supports, particularly the rectangular overarm, as well as in the work-holding fixtures together with the substantial tables on which they are mounted. The second factor, and one not to be overlooked, is the generous quantity of coolant supplied directly to the cutter through ample piping. It should also be noted that the fixtures are both simple and rugged. Standard steel vises lessen the number of special fixtures to be stocked and hence reduce the initial cost of the equipment.

In modern manufacturing, fitting is more apt to mean selecting carefully graded components than to mean scraping, filing or grinding parts to suit.

Seen and Heard

By John R. Godfrey

Growth of Welding

IF ANYONE still has doubts as to the strength of seams welded by the oxyacetylene or arc-welding methods, he should spend a little time in some of the plants making steel barrels. A comparatively light-gage steel is rolled into tubes of the right diameter, and seams are welded the length of the barrel. And then the real test of the seams begins.

The ends are flanged at right angles. The center of the barrel may be bulged in true wooden-barrel shape or it may have "hoops" put in, either by rolling or simply forcing out the metal from the inside, with dies. It is almost uncanny to see the metal stretch out into the desired shape and to realize that the two edges are held together by a weld. And the percentage of welds that fail, even under this treatment, is so surprisingly small that you can almost forget about it.

When it comes to reliability, these tests come pretty near proving this type of joint. The punishment the welded joints stand makes us wonder why we don't see more steel buildings with welded joints. As they seem bound to come eventually—why not now? And think what a relief it would be to have the new building next door go up without the clatter and din of driving rivets.

Future Markets for Machine Tools

Some machine tool builders are wondering and asking what is to take the place of the automobile industry as a field for machine tools. Not that the automobile industry is not with us still, but all agree that the days of great expansion are over. They seem to feel that the expansion of the big concerns will be offset by the smaller ones who fall by the wayside.

It is well to remember, however, that there have been few industries as spectacular in their demand for machine tools as the automobile industry, the only comparison being the sewing machine and the bicycle, which, for their day, made big demands for machine tools. And we can't have circus parades all the time.

We must also remember that civilization is becoming more and more dependent on machinery. Few households are without some mechanical appliances. The use of power-driven carpet cleaners, washing machines, sewing machines, refrigerating machines and the like is increasing daily. Egg beaters, hair dryers, massaging devices, floor scrubbers, etc., are on the increase and will continue. Motorized shop trucks are replacing those pushed by hand, conveyors are becoming more common even in small shops. We are all using more machinery and back of it all are machine tools of one kind or another.

After a miner skims the cream in the way of nuggets, he goes after the smaller, scattered particles. In the long run he usually gets more gold out of the "pay-dirt" than out of the nuggets. It's very apt to be the same with the machine tool business.

Many a machine or plan fails because the engineer does not consider, or does not understand, the attitude of the human beings who must operate the machine or work to the plan.

Book Reviews

Über den Einfluss des Machanischen Fahrwiderstand-ausgleichs auf die Berechnung der Eisenkonstruktion von Brückenkranen. By Dr. Luz David, Advisary Engineer of the Construction Bureau of Berlin. Forty-two pages, 4¾x6½ in., paper binding, 18 cuts, 2 tables. Published by Guido Hackebeil A.-G., Stallschreiberstr. 34, Berlin S 14, Germany. Price 3 marks.

A compact little handbook of calculations for the design of bridge cranes. Originally written twelve years ago as a thesis for the Doctor's degree, the author has since revised the subject with the idea of making the book useful for engineers interested in the design of cranes. The handbook starts with three typical examples of bridge crane problems, and follows the design through the calculations for the stresses of all members and parts. Each step is illustrated by diagrams or drawings.

Statistical Abstract of the United States, 1924. A Department of Commerce publication, prepared in the Division of Statistical Research, of which E. Dana Durand is chief. Eight hundred and twenty-four pages, 6½x9 in., paper covers. Published by the Government Printing Office, Washington, D. C. Price $1.

In one place, and in one small volume, a digest of practically every statistical subject covered by our government is made available, and brought up to date annually, under the title of "Statistical Abstract."

This, the latest edition, and the forty-seventh in the series, is distinctly an improvement over its predecessors, in two ways. First, a program of revision has just been completed so that this volume co-ordinates with the Commerce Year Book, a companion volume. Second, by condensing the tables, more material has been placed in fewer pages. By word of explanation, the "Abstract" contains only the figures and data of progress in nearly every activity in the United States, while the "Year Book" embraces the current comments and interpretations of business statistics.

The Statistieal Abstract may well form the nucleus of any sales manager's, or manufacturer's, library in matter of statistics for market analysis, production programs, or public speeches, wherever a record of the most recent past is sought.

Proceedings of the Thirteenth Annual Convention of the American Railway Tool Foremen's Association. One hundred seventy-eight pages, 5½x8½ in., flexible covers. Published by the Association, 11402 Calumet Ave., Chicago, Ill. Price $2.50.

The contents of the volume comprise papers and discussions that were presented at the last meeting of the association, held at Chicago, Ill., Sept. 2, 3 and 4. Line cuts and halftones are used in connection with the various topics to illustrate the practical methods that have been devised to meet the needs of railway-shop work.

Machine tool equipment for the toolroom is treated by bringing out the requirements for the shop that maintains a general tool-manufacturing and maintenance department or centralized toolroom, the medium-sized shop doing mostly maintenance work, and the smaller shop where the only work handled is the reconditioning of tools used on running repair work. In each case, the recommended type and size of machine tools and the special equipment or attachments are listed.

The standardization of tools in the locomotive and car shops is the most progressive movement undertaken by the association and considerable space is devoted to the subject, especially the economies that can be effected by standard tools made at a central point.

Jigs and devices for the railroad shop have been well covered. Although some of the tools illustrated are not labor-saving devices, they show methods of handling work more uniformly and correctly. Other subjects treated in the volume are the tool foreman's responsibilities, grinding in the railroad shop, the importance of the toolroom to the railroad, and the design of forging-machine dies.

The constitution and by-laws of the association, a list of members and the topics for the 1926 convention also are given within the pages.

A Report of Experiments to Determine the Relative Power Transmitting Capacity of Belts on Vertical, Angular and Horizontal Drives. By R. F. Jones, Published by the Leather Belting Exchange, 119 South 4th St., Philadelphia, Pa. The booklet contains the report on the results of experiments to compare the power-transmitting characteristics of belts run horizontally, vertically and at various angles with the horizontal. The information is intended to serve as a guide in the layout and design of the drives. This booklet, R-14, forms another valuable contribution to the work of the Foundation at Cornell University.

Decisions of Courts Affecting Labor, 1923-1924. By Lindley D. Clark and Stanley J. Tracy. Five hundred and fifty-one, 6x9-in. pages. Bulletin No. 391, published by the Bureau of Labor Statistics, U. S. Department of Labor, Washington, D. C. Price 70c. This bulletin is a collection of reports, drawn chiefly from the *National Reporter System* and the Washington (D. C.) *Law Reporter*, of interest particularly to the employee and employer. It includes reports on a great many cases including those involving decisions as to the status of the Railroad Labor Board and the Kansas Industrial Court, decisions on workmen's compensation, wage laws, labor organizations as well as employer's associations, the licensing of occupations and decisions on cases involving Sunday labor. The collection is a very valuable one to those interested in these problems and fills a need in this field that cannot be underestimated.

Tentative Standards for Plow Bolts. The American Society of Mechanical Engineers, 29 West 39th St., New York, N. Y., Sub-Committee No. 6 of the Sectional Committee on the Standardization of Bolt, Nut and Rivet Proportions, has drawn up tentative standards for plow bolts. The tentative standards are now being voted on by the sectional committee. Four types are covered: round countersunk, short square type; square-head countersunk type; heavy-key, round-head countersunk type; and reversed-key, round-head countersunk type.

Winning Solutions
of the Third Prize Problem

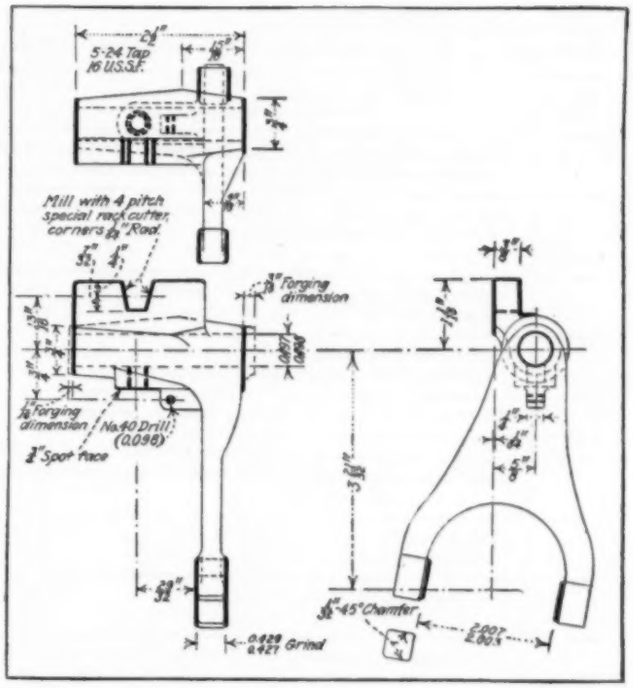
Conditions of the Problem

Lay out an operation sheet to show how and in what order you would machine the surfaces and holes indicated by heavy lines, and design the necessary jigs for drilling and reaming only. The design of the jigs must conform to your sequence of operations. Fractional dimensions have a tolerance of 0.005 *inch. The operation sheet must show, in addition to the sequence of operations, your selection of machines, speeds, feeds and floor to floor time.*

Material—Nickel steel—S.A.E. 2315, drop forged.

Depth of cut—$\frac{1}{16}$ to $\frac{1}{8}$ inch.

Total quantity—15,000 yearly (in lots of 1,000 each).



THE two winning solutions of the third prize problem, which was published on page 402, Vol. 63, of the *American Machinist*, are given on the following pages. One of the winners is not unknown to us. B. R. Sheets, Denver Rock Drill Co., Denver, Colo., was one of the two winners of the second prize problem, the solutions of which were published on pp. 663-664, Vol. 63, of the *American Machinist*. The other winner of this third prize problem is A. Speak, Selson Engineering Co., Ltd., Coventry, England.

The solutions are shown in the form of operation sheets with accompanying drawings. It is to be noted that both contestants begin the series of operations with the straddle milling of the end faces to 2½ in. apart, and then proceed with the drilling of the 0.498-in. hole. It is interesting to make a comparison with the method actually used to make this piece, which is a transmission gear shifter fork for the Franklin car. In regular production the first operation is to drill and rough ream the 0.498-in. hole, equalizing from the fork, and this is followed by the spot facing of both ends of the hole. The fork is then straddle milled to within the allowable grinding limits of the 0.429-in. dimension, after which the tooth lug and finally the tooth slot proper, are milled. The finishing of the No. 40 drill hole and the drilling and tapping of the ⅜-in. by 24 American fine thread (formerly S.A.E.) tap hole, are done in following operations. Franklin jigs are all set up in units of four which were originally of the indexing type. In several cases, however, the indexing feature has been removed by Franklin from the milling fixtures and the fixtures have been bolted directly to the table in order to prevent chatter under heavy cuts.

There are no outstanding features of the winning solutions. Of course, consideration was given to the practicability of the designs, the ease of inserting and releasing the work, and the absence of too much complication with its attendant high cost. Another factor that influenced the judges in their selections was the consistency in the operations, and particularly in the time of each operation, as shown between the plans submitted by the two contestants and the actual Franklin production schedule. One of the unsuccessful contestants, for instance indicated operation times that seemed unreasonably short. If space permits, this solution will be published later for purposes of discussion.

A noteworthy feature of Mr. Speak's design is that he has used a single jig to perform the three different drilling operations by providing feet on the three separate faces which successively rest upon the drill table. Such an arrangement not only lessens the total tooling cost, but also saves the time necessary to release the piece from one jib and to put it in the next. Mr. Speak included in his solution drawings for the jigs and fixtures used in all the operations listed, although these were not called for; the keynote of their design was simplicity and quick adjustability, i.e., ease of insertion and removal of the piece.

Mr. Sheets follows the procedure adopted by Franklin engineers of using the drilled and reamed 0.498-in. hole as a locating part. However, instead of using pins to hold the tooth lug, Franklin stabilizes the piece about the axis of the stud by means of a pin 2 in. in diameter mating with the semicircular arc of the yoke, which has been previously milled to this diameter. The fact that this radius was milled was unknown to the contestants and may have been responsible for their complete avoidance of this method of locating the piece.

There was considerable similarity in the methods proposed which made it all the more difficult to decide which of the solutions should be considered as the best. One interesting feature in this connection was the fact that solutions from both sides of the Atlantic were quite similar, showing that ideas and methods are more a question of conditions than of locality, and that the interchange of ideas has done much to produce similar methods in different countries.

Winning Solution Submitted by B. R. Sheets

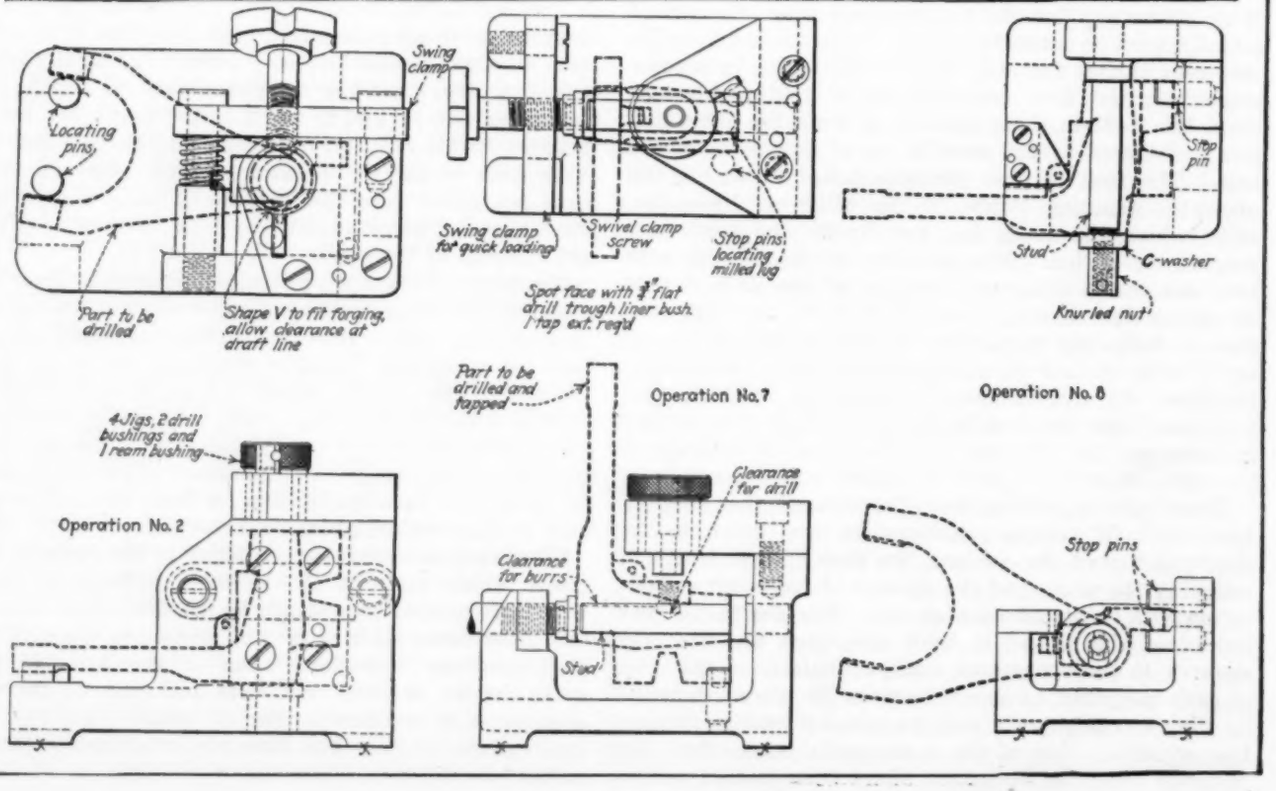
THE DENVER ROCK DRILL CO.
Denver, Colo.

OPERATION SHEET

PART Shifting yoke. DEPTH OF CUT $\frac{1}{16}$ to $\frac{1}{8}$ in.

MATERIAL Nickel steel, S.A.E. No. 2315, dropped forged. PRODUCTION 15,000 yearly in lots of 1,000 each.

Oper. No.	Description of Operation	Machine Tool	Feeds and Speeds	Floor to Floor Time
1	Straddle mill faces to 2½ in. dimension. Locate from contour of ¾ in. dia. and rest on outside of fork	No. 3 Cincinnati Pl. Horizontal	Feed, 3 in. per min. Speed, 45 r.p.m.	1.50 min.
2	Drill and ream 0.498 in. hole. Locate from contour or ¾ in. dia. and milled face	20-in. Barnes single spindle; quick change collets	Feed, 0.005 in. per rev. speed, 525 r.p.m.	3.00 min.
3	Straddle mill sides and top of ⅜ in. tooth lug. Locate from 0.498 in. hole and equalize from 2.007 in. fork	Same as Op. 1	Feed, 3½ in. per min. Speed, 55 r.p.m.	0.75 min.
4	Mill inside fork pads to 2.003-2.007 in. Locate from 0.498 in. hole and finished ⅜ in. tooth lug	Same as Op. 1	Feed, 3½ in. per min. Speed, 88 r.p.m.	0.75 min.
5	Mill 4-pitch rack tooth space—tandem fixture	Same as Op. 1	Same as Op. 4	0.75 min.
6	Straddle mill flats on fork to 0.440-0.445 in. and 0.898 in. from center of 4-pitch tooth. Use indexing fixture, two pcs. at a pass	Same as Op. 1	Same as Op. 1	0.75 min.
7	Drill, spot face, and tap $\frac{5}{16}$ in. 24 U. S. S. F. Use quick change collets and tapping attachment	Same as Op. 2	Feed, 0.003 in. per rev. Speed, 1050 r.p.m.	1.50 min.
8	Drill No. 40 (0.098 in.) hole	Sensitive Leland-Gifford	Feed, touch Speed, 3000 r.p.m.	0.75 min.
9	Surface grind one side of 0.429 in. fork to $\frac{21}{32}$ in. dimen.	Blanchard No. 10 Surface Grinder	Table speed, 17½ r.p.m. Feed, 0.001 in. per rev.	1.50 min.
10	Surface grind other side of fork to 0.427-0.429 in. Operations 9 and 10 are performed at one time. Fixture to hold 8 pcs., 4 in position for each operation respectively	Same as Op. 9	Surface speed 5000 ft. per min. Total time	1.50 min. 11.25 min.



Winning Solution Submitted by A. Speak

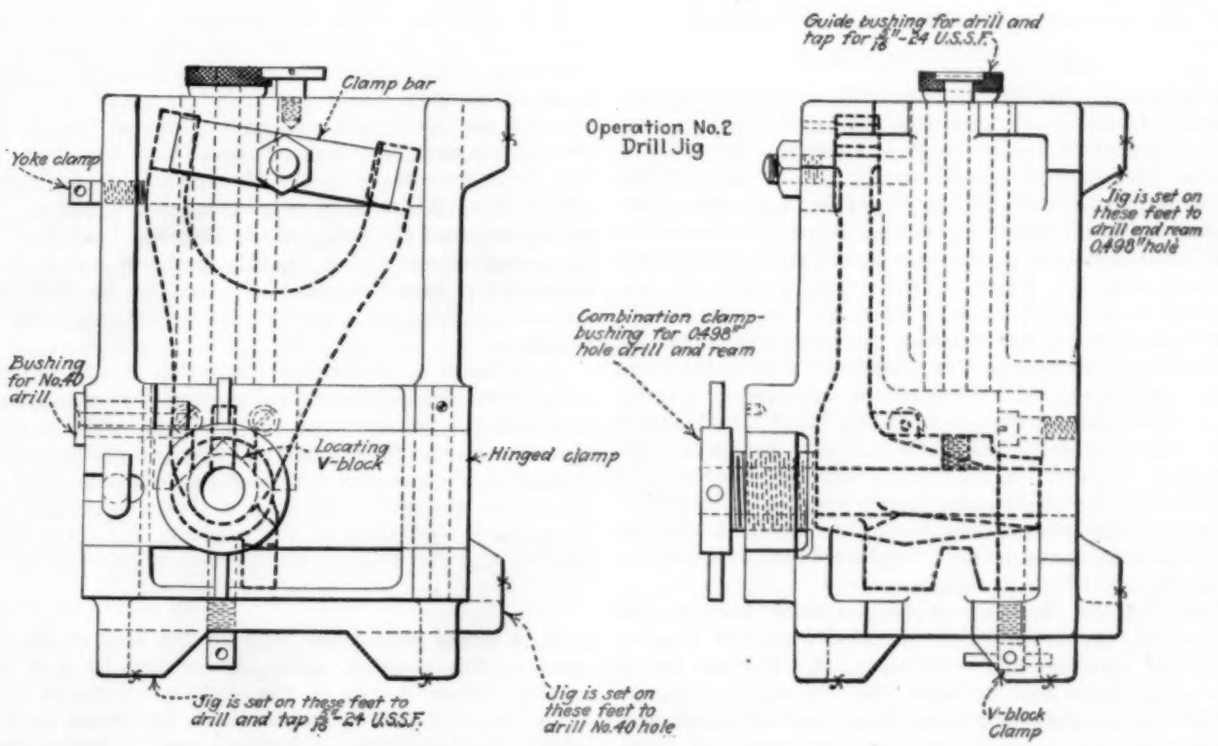
THE SELSON ENGINEERING CO.
Coventry, England

OPERATION SHEET

PART Shifting yoke. DEPTH OF CUT $\frac{1}{16}$ to $\frac{1}{8}$ in.

MATERIAL Nickel steel—S.A.E. No. 2315, dropped forged. PRODUCTION 1,000 lot; 15,000 yearly

Oper. No.	Description of Operation	Tools Required	Machine	Feeds and Speeds	Floor to Floor Time
1	Straddle mill 2½ in. faces and 0.429 in. faces (rough) in one setting. 18 pcs. in fixture	Special fixture and extra head with rotary table	Garven or equivalent	Cutter 45 r.p.m., table feed 0.020 in. per rev. of cutter. Good flow of coolant req'd	4 min.
2	Drill and ream 0.498 in. hole; drill, tap and spot face $\frac{5}{16}$"-24 U. S. S. F.; drill No. 40 hole. (This operation is illustrated)	Celfa drill; ¾ in. spot facing cutter	6-spindle Jones & Shipman, or 4-spindle Herbert	350 r.p.m. for 0.498 in. drill, 0.008 in. feed per cutter rev. Ream at 100 r.p.m. feed 0.020 in. per cutter rev.	4½ min.
3	Straddle mill 4 faces of ¾ in. lug. 3 pcs. milled at a time	6-pc. indexing jig. —3 working, 3 loading	Potter & Johnson Automatic, two tables	Cutters, 60 r.p.m., feed 0.020 in. per cutter rev.	2 min.
4	Mill gap with 4-pitch rack cutter. 3 pcs. milled at a time	4-pitch rack cutter same jig as for Op. No. 3 with slight modifications	Potter & Johnson Auto. Horizontal Miller	Cutters, 60 r.p.m., feed, 0.020 in. per cutter rev.	1½ min.
5	Straddle mill 2.007 in. gap. 3 pcs. at a time, 1 fixture loading	3-pc. fixture, 2 fixtures req'd	Same as Op. No. 4	Same as Op. No. 4	1 min.
6	Grind 0.429-0.427 in. faces, one face at a time. Full capacity of magnetic chuck, with boss portion of piece overboard	Magnetic chuck	Fazer surface grinder or equiv.		1 min.
				Total time	14 min.


Clamp bar
Yoke clamp
Bushing for No.40 drill
Locating V-block
Hinged clamp
Jig is set on these feet to drill and tap ⅝"-24 U.S.S.F.
Jig is set on these feet to drill No.40 hole
Guide bushing for drill and tap for ⅝"-24 U.S.S.F.
Operation No.2 Drill Jig
Jig is set on these feet to drill and ream 0.498" hole
Combination clamp-bushing for 0.498" hole drill and ream
V-block Clamp

Inspecting the Policy of a Manufacturing Plant

By John Younger
Associate Editor

IT IS easy to inspect a particular part of a product with the aid of micrometers to check up with the blueprint. It is also comparatively easy to inspect a sample of the product either by functional test or by detailed measurement analysis. When it comes to testing a large number of products of the highly complex nature, however, the means to be adopted are usually complex in themselves and sometimes are exceedingly difficult to put in operation.

Take a motor vehicle which consists of 10,000 to 20,000 individual parts, each of which is supposed to be accurate. Suppose that a purchaser of a fleet of trucks, for example, wants to give a species of inspection on such a product. The question arises as to how he is going to do this in a satisfactory and yet an economical manner. To actually see that all the individual parts were interchangeable, would require a staff of inspectors commensurate with those employed by the manufacturer. Even then the purchaser would not be sure that the manufacturer was not putting something over on him.

There is one method, however, by which an inexpensive yet satisfactory check can be made, and that is by making an analysis of the policy of the company. It is interesting to observe how the policy of the company can be reflected by the individual actions of the workmen. If the company is not honest with itself, it will be found that the workmen are scamping the job and putting one over on the management for themselves. If the company has a sincere policy, then the workmen themselves will on the whole try to live up to the high standard in agreement with this policy.

Living Up to Standards

During the war one of the allied governments purchased a large number of trucks from one of our leading motor manufacturers. It was necessary that these trucks conform to high standards, and in view of the situation at the time it was advisable that some check or inspection be made. The chief inspector detailed by the allied government had an exceedingly simple way of analyzing the policy of the company, and by his method he received vehicles of a high standard. He first interviewed the general manager and obtained from him a statement as to what the policy of the company was in regard to furnishing material in accordance with the blueprint. He was told that the blueprint was their authority and that the shop produced only material which was in accordance with the specifications laid down. He was assured that there was an elaborate inspection department, whose purpose was to detect any infringement or variation from the blueprints and to scrap the offending material.

This foreign inspector thereupon went down to the inspection department and his first question was to see what material had been scrapped. He was led to the scrap heap and he went over in fairly complete detail the reasons why each piece was scrapped and determined for himself the fact that many of these pieces were scrapped because of minor variations from the prints. He recognized that only a company living up to a high policy would have carried out this rejection to this degree. He then took the piece of which there seemed to be the most scrapped, went back to the shops and traced the piece completely through all its manufacturing operations, checking up and inspecting it at each step as he went along. He asked the men what limits or tolerances were allowed on the particular portion of the piece and then went to the part into which this piece fitted and again checked up on the limits allowed. From here he went to the assembling department and satisfied himself that these limits were in accordance with good engineering design and workmanship. He followed this procedure several times and on many pieces until he arrived at the conclusion that the policy laid down by the general manager was indeed reflected by the workmen and that each workman and foreman was honestly endeavoring to live up to the standard set.

Double Inspection Tried

His next check was on the equipment of the vehicle. Most of these war-time products were equipped with very complete tool boxes. It was quite a temptation to some men to see good tools go out in a tool box and often petty thefts occurred. The foreign inspector interviewed the man who had the responsibility of sealing these tool boxes and satisfied himself as to just how honest this man was. A very satisfactory interview was given and the inspector felt that everything was in complete accordance with what was required.

A final test was made after the trucks had been crated and were ready for shipment. One truck was taken out of the shipment and was ordered to be uncrated. This particular vehicle was then inspected most thoroughly and reassembled to make sure first, that all the equipment was there; second, that it performed its various functions; and third, that the various parts were made to the blueprints. An inspection test such as this was, of course, expensive, but in view of the fact that the policy of the shop had been found to be exceedingly satisfactory, this final test was only resorted to at rare intervals. Fortunately no case came up where there was any undue departure from the standards.

As a result of this policy inspection it was felt that a detailed inspection of the product was unnecessary and that the management and the shop could be relied upon to give a thoroughly satisfactory product agreeable to the purchaser. Therefore, only one man was placed in the shop; he was a clerk responsible for checking the numbers of the products and other designations and for making out the necessary invoices.

It is stated that more than 95 per cent of the coal used in this country, today, is handled by men with shovels before it gets to the surface. Some of it has to be handled twice, and to these handlings must be added the handlings in delivery and in firing, in all except the large plants. There is surely room for much handling machinery in this field alone.

Modern Tooling Methods for Turret Lathes

By M. E. Lange
Production Engineer, The Warner & Swasey Co.

Increasing production by the use of piloted tools—Examples of both overhead and center piloting—Details of plain chucking equipment—Permanent set-ups

IN REDUCING the tool cost for chucking work, care must be taken to select equipment that will increase production to the maximum, as well as keep the investment low. A careful study of all the work to be produced on one machine in a particular shop will give the answer to the important question, Will piloting increase the feeds and hence the production, without loss of accuracy? If so, then the chucking equipment for the given shop requires the feature of piloting.

Will Piloting Increase the Production?—Let us first consider the two general types of work shown in Figs. 165 and 166. In Fig. 165 is shown a variety of work that in general is light, or where the length of the cuts taken from the hexagon turret on the out side diameters is short, so that increasing the feed will not reduce the total machining time materially. In several cases the material is either aluminum or bronze.

In the general type of work shown in this group it is not necessary to pilot the tools, because the cuts are short and the material is comparatively easy to machine.

Therefore, it is possible to reduce the cost of the tooling to some extent by using a plain set of chucking equipment, such as is described and illustrated in this article.

Work where much heavier feeds can be used if pilots are provided is shown in Fig. 166. A brief consideration of the nature of the pieces will show more clearly just how and why piloting will increase the production.

Example 10—The length of the outside turning cut on hard steel is fairly long, so that heavier feeds will reduce the total time.

Example 8—The outside turning cutter for this job has considerable overhang, which prevents maximum feeds unless pilots are used.

Example 13—The outside diameter of this piece must be held to limits for accuracy of ±0.001 in. Here piloting is necessary to maintain these limits with coarse feeds, because the steel is tough.

Example 6—Concentricity of the blind center-hole and the outside rim will be destroyed by heavy feeds unless piloting is used.

Hence, we may say that the work in Fig. 166 requires universal chucking equipment with piloting, if maximum production is to be obtained. In fact, if one-fourth or more of all the work to be done on a particular machine can use piloting to advantage, the additional cost will be well justified.

> When work is stiff enough to withstand heavy feeds, maximum production can be obtained by the use of piloted tools. Whether the tools shall be piloted from overhead or in the center, depends largely upon the class of work to be done

Overhead or Center Piloting?—Where piloting is necessary for maximum production the question arises, Shall we use overhead or center piloting? By overhead piloting is meant a standard bar mounted in the top of the tool, passing into a bushing held in a bracket at the top of the head of the machine. By center piloting, a special bar held in the center of the turret face, and passing into a bushing inside the spindle, is referred to.

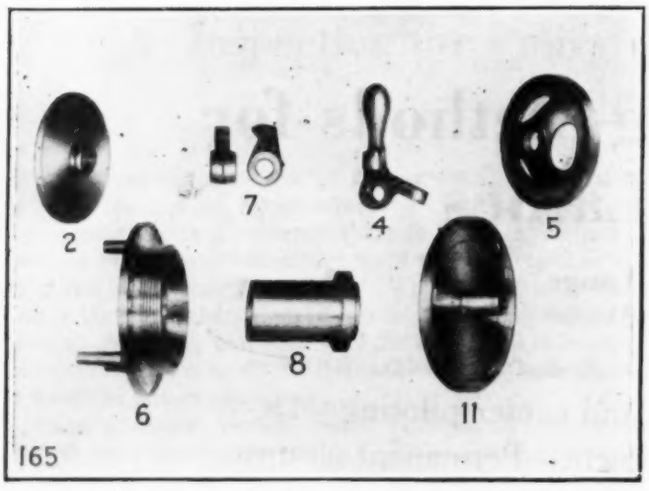
The answer to this important question depends upon whether production in the individual shop is in small lots or quantity lots.

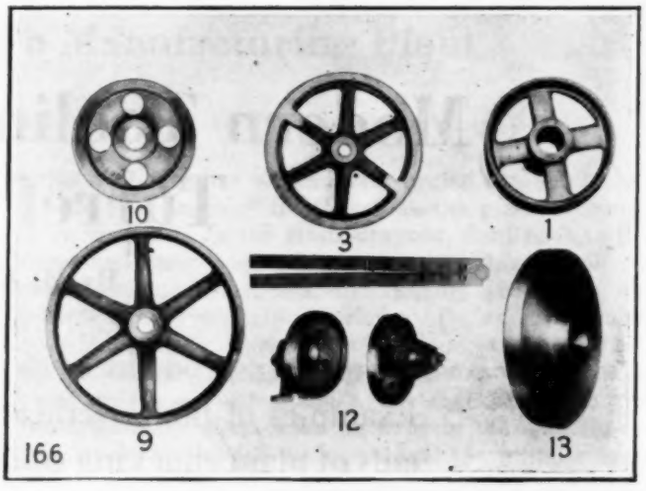
Small-lot production—Where work is made in quantities of 5 to 100 pieces in a lot, the investment in one set of standard overhead-piloted tools with stub boring bars is suggested to handle the great variety of work. Center piloting requires a variety of special bars of different sizes for different jobs, and is unduly expensive for small lots.

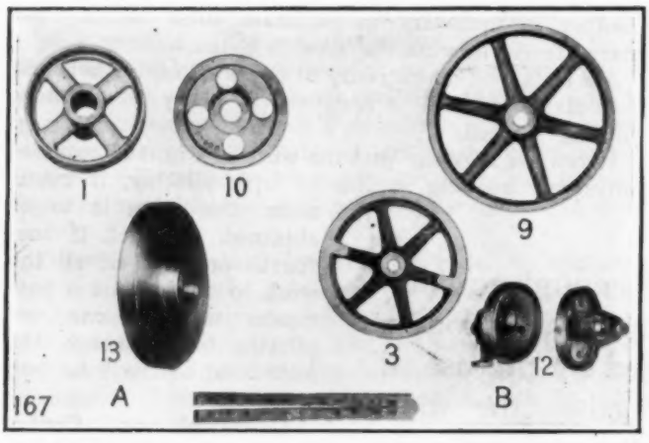
Quantity production—Where work is produced in large quantities, relatively few special and expensive bars are needed and center piloting becomes permissible. However, center piloting cannot be used for work without any center hole, such as Example 12 in Fig. 167. Also it is not advisable for work with too small a hole for a rigid center bar, such as Examples 3 and 9, or for work on a ram-type machine where the work is so long that the center-piloted bar cannot be withdrawn from it.

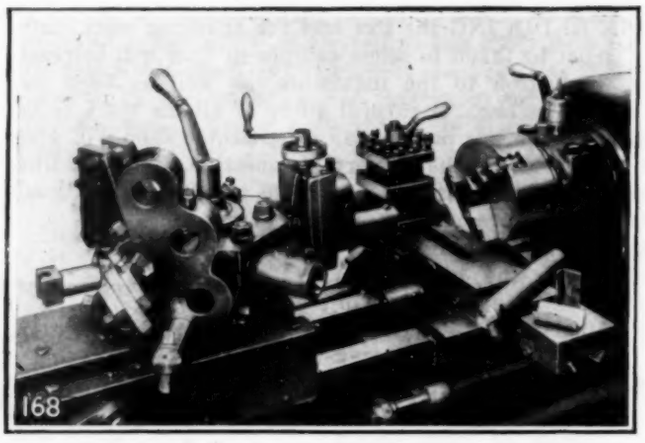
Two Types of Chucking Equipment—In Fig. 168 is shown a plain set of chucking equipment recommended

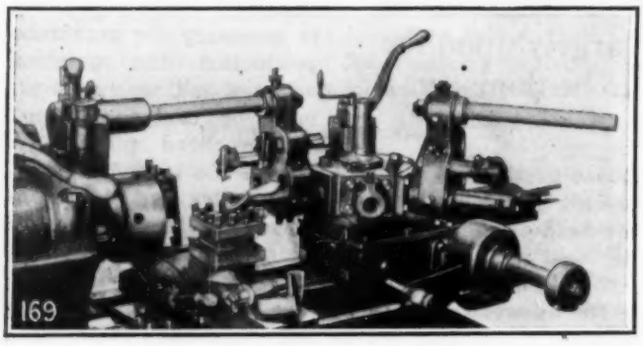
The ninth article. The tenth will appear in an early issue.











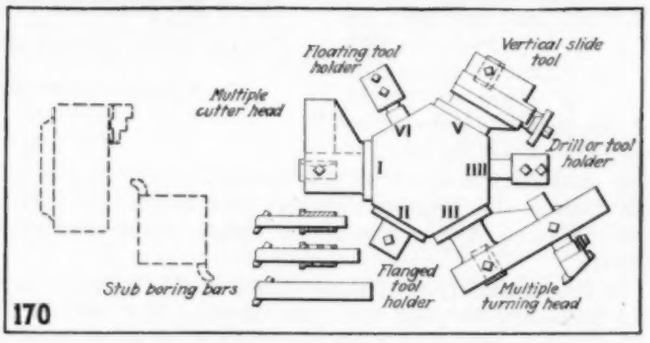


*Fig. 165—Work on which production cannot be increased by piloting. Fig. 166—Work on which production can be increased by piloting. Fig. 167—*A, *Types of work rquiring either overhead or center piloting.* B, *Types of work on which center piloting cannot be used. Fig. 168—Plain chucking equipment for light work. No piloting for small lots—Center piloting on quantity lots. Fig. 169—Overhead-piloted equipment. Fig. 170—Plain chucking equipment*

for light work where piloting is unnecessary, or for center piloting on quantity work.

In Fig. 169 is shown an overhead-piloted set recommended for work where the overhead pilot is best adapted for use.

The plain set of chucking equipment shown in detail in Figs. 170 to 182, is suitable for small- and average-lot production where feeds cannot be increased through overhead piloting, or for the quantity production of work where the variety of center-piloted bars required would soon pay for themselves.

The complete set is shown in the tool layout in Fig. 170, and the individual tools are given in the other illustrations, together with tool diagrams. The information about each tool is condensed, but the preceding illustrations in the many typical chucking layouts have already illustrated the wide variety of facing, boring and turning operations possible with this one set of universal equipment. Each tool may be quickly adjusted to handle all the work within the cutting range of the machine.

The multiple-cutter head, Figs. 171 and 172, is a narrow tool for holding inexpensive forged cutters for turning, boring, facing or chamfering. A rocker bushing in the center hole can also be used for adjustable, forged boring-cutters. Stub boring bars may also be held in the center hole.

The flanged toolholder, Figs. 175 and 176, is a rigid,

extension holder for shank tools. Often such extensions are required to overcome interference of tools in adjacent stations of the turret with cutters on the cross-slide. By means of standard bushings, shanks of smaller size may be accommodated.

The multiple turning head, Figs. 173 and 174, is used with angle cutter holders which can be mounted in any of the several holders, either singly or several at one time for multiple cuts. For finishing cuts, the adjustable-angle cutter holder shown in the diagram is best. A rocker bushing may also be used in the center hole.

The drill holder, Figs. 177 and 178, has a sufficiently deep hole to assure a solid mounting for drills, counterbores or the like. The hole and shank are of the same diameter, hence the holder may be used as a ready extension in the flanged toolholder for shank tools. Bushings may be used to accommodate tools with smaller shanks.

The vertical-slide tool, Figs. 179 and 180, is very rigid, and is used for holding forged cutters and stub boring bars. On account of its strength it can be used for heavy boring cuts while the large dial and clips make accurate setting a simple operation.

The floating toolholder, Figs. 181 and 182, is for holding reamers so that a small amount of float is provided to correct slight inaccuracies of alignment. A hole close to the same size as the reamer, is thereby assured, even when there is an inaccuracy in the tool shank or in the adapter bushing.

The addition of the overhead-piloted feature to the universal set of chucking equipment, provides rigidity for heavy feeds and also makes possible the use of a pilot in many cases where the work has no center hole, where the hole is too small to permit the use of a sufficiently rigid center bar, or where the pilot cannot be withdrawn because of the limitations of the length of travel of the turret slide.

The overhead-piloted set differs from the plain set in two tool stations only.

Station I of turret—An overhead-piloted, multiple-turning head, Fig. 183, is substituted for the multiple cutter head, Figs. 171 and 172, in Station I, and a

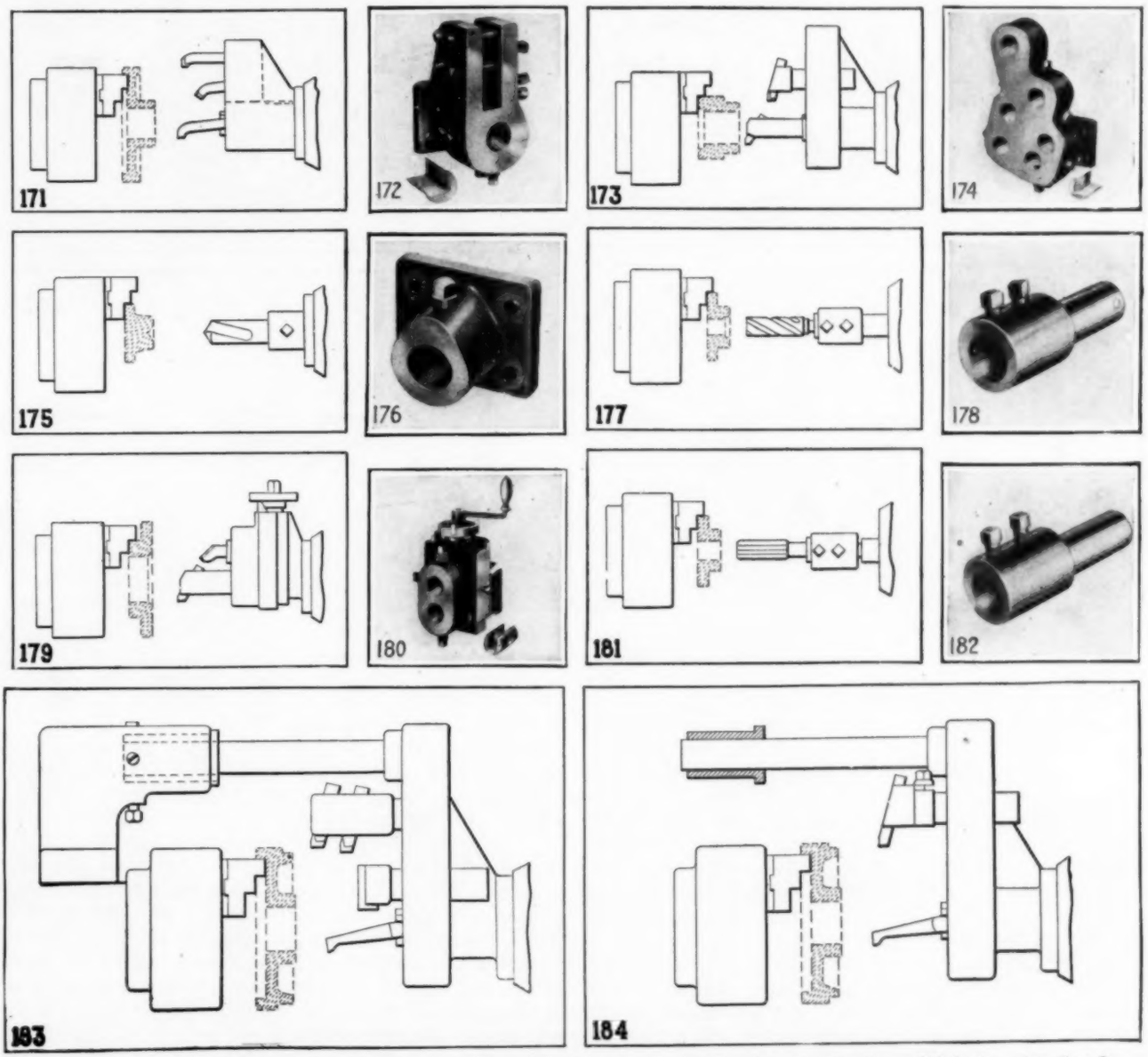
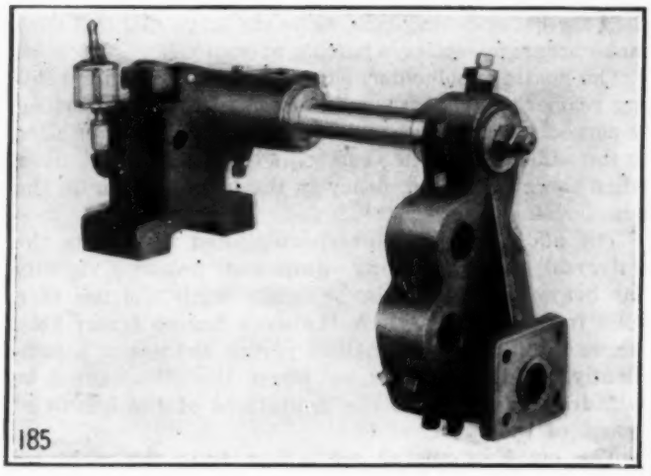
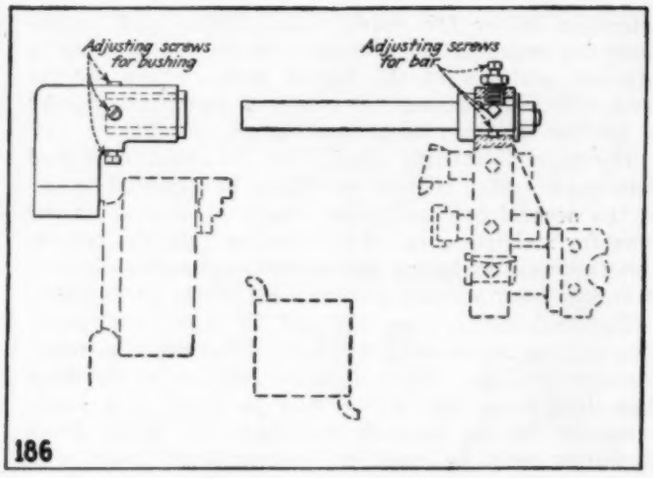
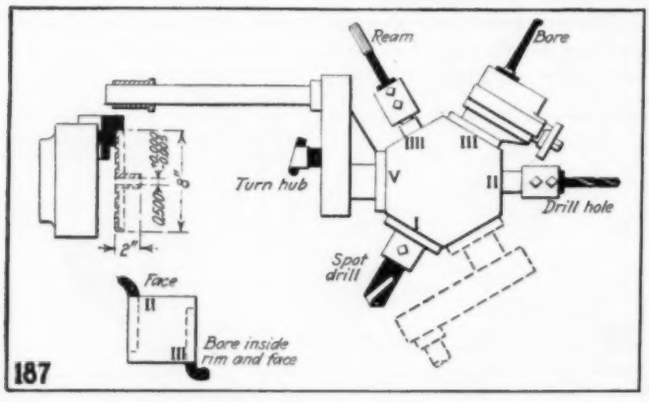
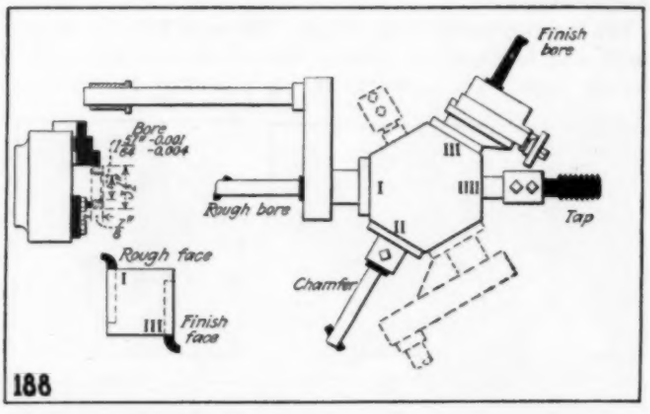


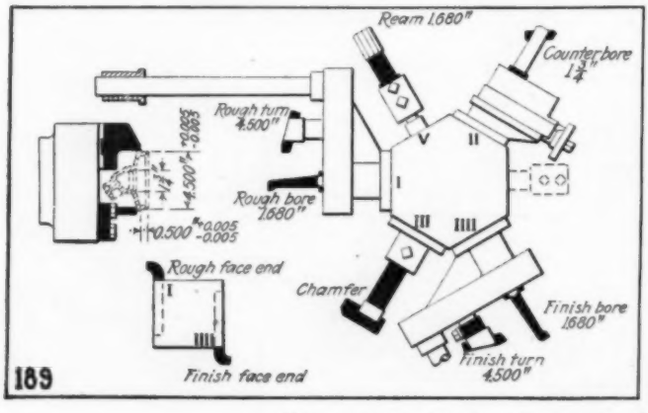
Fig. 171 to 182—Details of plain chucking equipment. Fig. 183—Overhead-piloted, multiple-turning head. Fig. 184—Another multiple-turning head with overhead piloting

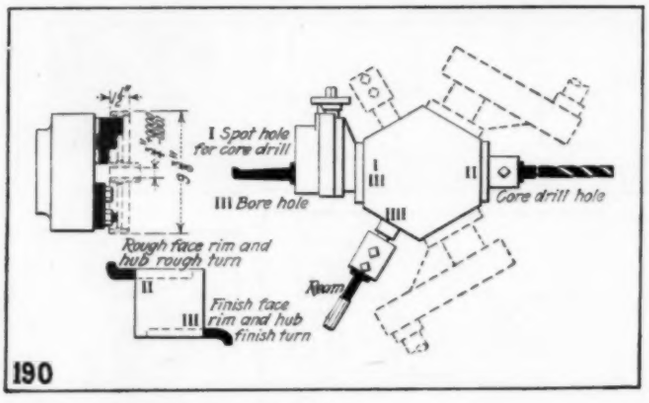











I Spot hole for core drill
III Bore hole
Core drill hole
Rough face rim and hub rough turn
Ream
Finish face rim and hub finish turn
190

Figs. 185 and 186—An overhead-piloted tool and its construction.
Figs. 187 to 190—Examples of permanent set-ups

bracket is mounted on the headstock of the machine.

Station III of turret—An overhead pilot bar, Fig. 184, is added to the multiple-turning head, Figs. 173 and 174, used in Station III of the plain type, which already carries an ear on the head for this purpose.

The construction of the overhead-piloted tool is shown in Figs. 185 and 186. The overhead-pilot bar is mounted in the body of the multiple-turning head, and enters a corresponding bushing in the bracket on the head end of the machine. The important feature of this tool is that provision is made for the adjustment of the bar where it is held in the turning head by four screws, without sacrificing any rigidity. The same provision for adjustment is given for the bushing in the bracket. Thus any loss in alignment which may arise through wear of the bed, or through shifting the tool from one machine to another, may be quickly compensated for. Once this alignment is set when the tool is mounted for the first time, no further adjustment is necessary for a considerable period.

The set-up time for this tool is the same as if no bar were used. Fig. 186 shows the close and rigid tie-up between the turret slide and the head end of the machine without sacrificing tool clearances.

The overhead-piloted set costs about one-third more than a set of the plain type. The substantial increase in production through heavier feeds, when the overhead-piloted type can be used to advantage, will soon pay for this difference. The entire cost of the overhead-piloted set for a 16-in. ram-type machine is about 22 per cent of the cost of the machine itself. The equipment will handle a great variety of work by shifting the cutter holders and the stub boring bars.

The tools of either set of chucking equipment may be arranged in a permanent set-up on the hexagon turret, similar to that described for bar tools. Then the

only changes necessary in changing from job to job, are the shifting of cutters and cutter holders and the setting of the machine stops.

In order to illustrate this more clearly, four set-ups on the same machine are shown in Figs. 187 to 190. The different jobs vary considerably in the type and kind of work, but the lots are all 100 or less. Many of the jobs are similar to the one in Fig. 189, and require piloting for maximum production, using Stellite cutters, so that overhead pilots are used. Any changes necessary from a previous job are indicated by solid black.

Set-Up Time on Four Jobs

Job. No.	Name	Quantity per Lot	Total Set-up Time	Set-up Time per Piece
1	Disk	50	60 min.	1.20 min.
2	End nut	35	70 min.	2.00 min.
3	Tank base	100	105 min.	1.05 min.
4	Friction wheel	20	50 min.	2.50 min.

A study of the exact changes from job to job will emphasize the simplicity of tooling up for a new job when the permanent set-up is used. The accompanying table gives the exact set-up time for each job.

Foreign Trade as a Co-operative Venture

By Herbert C. Hoover
Secretary of Commerce

Extract from an address delivered to the Export Managers' Club

THE immediate purpose of those engaged in foreign trade is remunerative adventure for the trader. But it has a far wider national importance than this and the men engaged in it are engaged in a far more significant mission.

Foreign trade has become a vital part of the whole modern economic system. The war brought into high relief the utter dependence of the life of nations upon it. The major strategy of war is to crush the enemy by depriving him of it. In peace time our exports and imports are the margins upon which our well-being depends. The export of our surplus enables us to use in full our resources and energy. The creation of a wider range of customers to each production unit gives to that unit greater stability in production and greater security to the workers.

And we may quite well view our exports from the other side of the trade balance sheet. They enable us to purchase and import those goods and raw materials which we cannot produce ourselves. We could probably get along as a nation if we had to suppress the 7 to 10 per cent of our production which goes to export, but our standard of living and much of the joy of living are absolutely dependent upon certain import commodities.

As the whole world increases in population and as its standards of living grow with every scientific invention, with every better utilization in national resources, with every step of education and desire, so does all international trade increase. Steam, electricity, the internal combustion engine and what not have all of them increased the productivity of peoples, expanded their needs for imports. For decades, or for centuries for that matter, the aggregate foreign trade of the world has grown bigger and bigger. The war set us back, but the upward movement is now resumed. We will have our share of it.

In fact, as I have said, a considerable part of the imports of each nation—and therefore the trade of the world—is goods which a nation cannot itself well produce. This sort of trade interlocks the whole world and increases automatically with increasing population and increasing standards of living. By our own prosperity we have increased the exports to us of other nations by 60 per cent in volume in twelve years. The great problem in our foreign trade, however, is the export of competitive goods, but if we are intelligent we should be able to command our share of the competitive goods.

In considering our position in this respect we may well take stock of our experience in the past. In our measurement of progress we must naturally revert to pre-war for our base because of the terrific dislocation that arose from the war. Likewise, if we would have any true measuring stick we must make allowance for the shifting value of currencies.

With these adjustments onto a quantity instead of monetary basis export trade for 1925 was 37 per cent above 1913. Although 1925 was a good year it marked no sudden increase, as in 1924 our exports stood 30 per cent quantitatively above 1913. Likewise, as I have said, our imports for 1925 on a quantitative basis were 60 per cent above 1913. In none of the European combatant nations have exports upon a quantity basis yet exceeded their pre-war footing. Nor can this increase in our trade be laid to natural resources or non-competitive goods or some fortuitous cause. Our exports of manufactured goods—our most competitive group—have expanded even faster than the other groups in our trade, yet our factories pay the highest real wages in the world.

If we examine the reasons why we should have been almost unique among nations in this progress I believe we can justly claim that it has been due to certain distinctively American accomplishments, and that in these accomplishments lie the confidence for the future. Our expansion of foreign trade is a part of our domestic progress, both socially and economically. I would first mention the accumulative value of the intensified education, both elementary and higher, which we have been dinning into the American youth over the last thirty-five years. In this time we have multiplied our students in institutions of higher learning by 400 per cent. Today we have more than all the rest of the world put together. We have trained technical personnel in every avenue of production and distribution upon a scale vastly larger than that possessed by any other nation. We have realized from this and many other causes a

great advance in business organization and a great adaptability to new ideas and to shifting demand.

Our work people have increased in education and skill. Above all, they are largely free from the economic fallacy that restriction of individual effort increases the number of jobs. Our national unions have long since declared against such theories. We are reaping the benefits of some 600 industrial research laboratories, mostly established in the last twelve years. They are ceaselessly searching for invention and for every economy in the use of materials and method. Under the pressures of high wage we have ruthlessly revised our industry with every new invention.

Beyond this, there is great and co-operative movement in American industry and commerce for cutting out waste in a thousand directions through improved business practice, through simplification of processes and methods. Furthermore, we have had a great advantage which we must not deny, in that by volume production, made possible through a great domestic market, we have been able by repetitive processes to apply or focus every advance into standard commodities of high quality and low cost of production.

The cumulation of these forces has increased our national efficiency to a degree which I hesitate to express statistically lest we appear to exaggerate. But I might observe that by and large, while we have increased our population 16 or 17 per cent in a dozen years, we have swelled productivity of the nation by somewhere in the neighborhood of 30 to 35 per cent. Our farms produce 13 per cent more with the same number of farmers as twelve years ago; our railways carry 22 per cent more traffic with about the same number of men. We have tamed the kilowatt into the friend of man. We have now domesticated some 68,000,000,000 hours of them annually where we used 23,000,000,000 twelve years ago. They increase output and decrease sweat.

Means of Holding Foreign Markets

These are the reasons why we are able to sell goods of high quality, produced under the highest real wages in the world in competition with goods produced under lower standards of living. These methods are no secret. They are open to the world. But they are rooted not alone in technology, which can be adopted by all intelligent people. They are rooted in social conceptions which penetrate far deeper and which promise not only greatly for the future in our standards of living at home, but, of more pertinent interest on this occasion, they are the basic assurance of our continuing growth in foreign trade, both exports and imports. These are the fundamental forces which promise for us our share of the world's increasing demands even of competitive goods, if we keep them in motion.

But we will not hold or gain in the world's business by resting upon past accomplishment. We can hold it by increasing our effort in education, in the elimination of waste, improvement in transportation, by cultivation of scientific research, by constant scientific improvement in our business administration both at home and abroad. And we need more definite policies in these matters from our manufacturing executives. We need concern ourselves with longer view policies. And in these matters such associations as yours are of prime importance. Foreign markets are more difficult to establish than are domestic markets. They cannot be held by ruthlessly starving the foreign customer whenever the demand for goods at home increases, with the expectation that they can be expanded easily whenever we have a moment of depression. I said that foreign trade is a vital part of our whole system; it is not a spare part to be used in emergencies.

And we have need for a stronger American selling staff abroad. Goods sell upon service of the merchant, as well as upon price and quality. We need more actual American wholesaling established in foreign markets. Too much of our export to neutral markets is a jobbing trade through the nationals of those countries with which we must compete. We are never secure from their natural preference for goods of their home country whenever it suits them. We have many hundreds of instances of losses by such methods.

Importance of Exports

And expansion of the exports of our manufactured goods is of the utmost importance to us. As our population increases we shall consume more of our foodstuffs, and this important item in our exports will tend to decrease because our easily cultivable land is now well occupied. The day of unlimited lands is over. If we are to maintain the total volume of our exports and consequently our buying power for imports, it must be by steady pushing of our manufactured goods.

We have the question propounded daily as to whether with a stabilized Europe we can continue successfully to hold our own share in the growth of the world's trade in competitive goods. It permits argument both ways, and we may recede on some particular commodities. I have the firm view, however, that the recovery of Europe will by and large help our foreign trade. Trade grows on prosperity, not on poverty. I believe that in most trades it has been more difficult to compete with Europe in neutral markets during the past few years against the underpaid labor and lower overhead costs of depreciating currencies than it will be when Europe is more stable and they have recovered their pre-war standards of living. Moreover, as Europe gains in stability and their living standards increase, they will become better customers for our goods in direct trade.

In a large sense the major proportion of foreign trade is a co-operative effort among nations to secure the greatest total output and total consumption. Foreign trade is too often visualized as a sort of battle. It is a misfortune that the terminology of trade has been so much infected by military terms. We speak of export trade as a matter of conquest, we talk of trade wars, trade strategy, of economic power—all carrying many implications of extermination. In larger vision our export trade does not grow by supplanting the other fellow, but from the increased consuming power of the world.

I do not wish to be understood as saying that we are going to obtain our share of these increases without effort and without competition. What I wish to get clear is that in the large view our exports are not based on the destruction of our competitors, but on insistence that we shall participate with them in the growth of world demand.

The General Motors Corporation has a Saving Fund Class in which employees may deposit money at 6 per cent, plus a dividend depending on the earnings of its stock. In 1925 this gave a little better than 9 per cent total earnings on the deposit.

Soldering, Brazing and Riveting Sheet Metals

By A. Eyles
Manchester, England

Soldering aluminum—Preparation of joints for brazing and the fluxes to be used with them—Composition, melting points and other characteristics of brazing alloys

SINCE aluminum became extensively used, it has been demonstrated that it can be soldered, but not so readily and effectively as other sheet metals. The difficulties to be overcome are due to:

1—The peculiar resistance to interfusibility, due to the formation of a film of oxide at soldering temperature, preventing interunion with the aluminum beneath it. In consequence, the solder does not firmly adhere to the surfaces to be united.

2—The thermal conductivity of the aluminum.

3—The high position of aluminum in the electrochemical series.

4—Strong electrical action that occurs between aluminum and alloying metals in the presence of water.

When soldering aluminum, it is essential that the oxide film on the surface should be removed before cohesion with the solder can take place, and since it forms again on exposure to the air, instantaneously, it is necessary that the removal of the oxide and the covering with solder should be simultaneous. In soldering other sheet metals, the oxide can be removed chemically. With aluminum, this is a difficult problem, therefore it should be removed mechanically by abrasion. Aluminum solders that the writer has found most satisfactory are composed of tin, zinc, and aluminum, with from 5 to 10 per cent aluminum, 15 to 20 per cent zinc, and 70 to 90 per cent tin. A typical composition is aluminum, 5 per cent; zinc, 15 per cent; and tin, 80 per cent. Some aluminum solders contain copper and phosphor-tin, but never in excess of from two to three per cent.

Tinning the surfaces of aluminum preparatory to soldering is an important operation. When soldering joints in sheet aluminum, the distance of the overlap of the pieces to be joined should be much less than that usually allowed for other sheet metals. The reason for this is that the solder will not flow by capillary attraction into an aluminum joint, even when tinned, as it does into brass, copper, or tinned-steel joints. The process of tinning is accomplished by heating the surfaces to be soldered to a temperature somewhat above the fusing point of the solder used, a satisfactory condition of the tinned surface being obtained by rubbing with the point of a bright steel tool, so as to remove the oxide film and allow the solder to act upon the clean surface. At the same time any dross that may have formed should be removed. After the surfaces to be joined have been tinned, they may be soldered together by lightly pressing them in contact, again heating the metal and solder to the desired temperature, and finally rubbing thoroughly with a well-tinned, hot soldering tool. In the actual operation of soldering aluminum, it is essential that all joints should be kept under slight pressure until the solder has thoroughly set. This method prevents disruption of the joint. The best means of working is to have an atmospheric blowpipe or blowlamp flame to heat up and play on the work during the process of soldering. Good results will not be obtained if the metal is soldered in a dilatory manner. Smartness is the keynote to successful aluminum soldering. Soldered joints should be used only where they will not be exposed to moisture, and in all cases it is advisable to protect the joint by bitumastic paint or varnish, which acts by excluding moisture. The following is a case in point with reference to the disintegration of aluminum solders in damp situations. Some few years ago the writer made two aluminum vessels of triangular shape, 14 in. in depth, sheet aluminum 0.040 in. in thickness being used. The joints were made by using a solder composed of aluminum, zinc, and tin. One of the vessels was used for filtered water, and the other for dry materials. Both were made at the same time and by precisely the same process. After a lapse of a few months, the vessel that had been used for the filtered water came back to the shops for repairs, the defect being that the joints were leaking. Upon examination, it was found that the solder had badly dis-

There has always been more or less difficulty in making satisfactory joints in aluminum by soldering. The reasons for the difficulty are given in this article, together with instructions for successfully doing the work. Brazing sheet metals has long been practiced by comparatively few men, who have always been loth to impart the secrets of the trade to their fellow workmen.

The second part of the article. The first part was published on page 443. The article will be concluded in an early issue.

integrated, in fact the greater portion could easily be stripped from the aluminum, whereas with the other vessel, the solder was still in good condition. The writer has several soldered articles of aluminum, as well

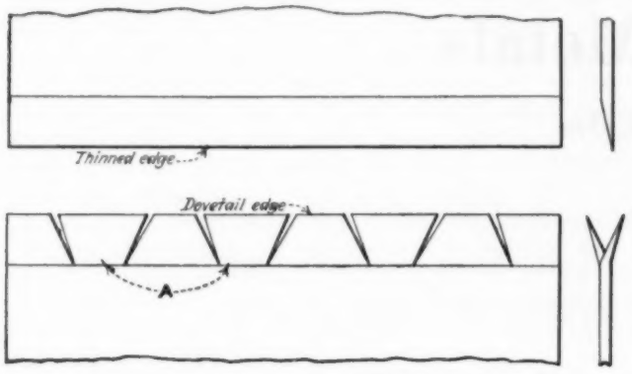


Fig. 10—A dovetail joint

as aluminum soldered to brass, that were jointed in 1906. These articles are still in service, but it must be stated that the joints were protected with paint and varnish, and were not exposed to very severe conditions.

The work of the brazier and coppersmith has been invaded during recent years, by the manufacture of seamless, sheet-metal products, pipes, tubes, etc., and by the electrical and gaseous systems of welding. However, the process of brazing is still used to a very great extent for joining parts where greater strength is required than can be obtained by soft soldering, or where the work has to withstand a degree of heat that would cause soft solder to fuse. Moreover, it is not always desirable to heat sheet metals to be joined, to the relatively high temperature necessary to weld them, since welding temperatures might seriously distort or deteriorate the metal or adjacent parts, especially if the articles are constructed of brass or bronze. Hence in many cases brazing methods are decidedly more preferable.

Until the remarkable development of autogenous welding for jointing sheet metals, brazing was considered the ideal process where strength and durability were required, for in a properly-made brazed joint in either brass, copper or iron, the joint will be found to be almost as strong as the rest of the work. The writer has made many experiments during recent years with regard to the strength of brazed joints, and has invariably found that when properly brazed, the strength of the joint is from 85 to 95 per cent of that of the sheet or plate. Whatever may be the composition of the brazing material, it is always desirable to retain to a great extent, the strength, malleability, fusibility, and color of the metal to be jointed.

The fusing point of the spelter or solder used, should be as close as possible to that of the metals being brazed, since a more tenacious junction can thus be secured. A brazing alloy may fuse readily and may appear to be all that is required, yet its very property of quick fusion, while eminently suitable for some classes of work, may stamp it as being equally undesirable for other work. The nature of the work in hand should always determine the approximate fusing point of the brazing material to be used. High fusibility is a factor of particular importance in railway work, where the effect of heat on mechanical properties has to be considered. Microphotographic examination shows that a brazing spelter actually diffuses into, and alloys with, the metal of the joint, when well brazed. Table II gives the composition of brazing alloys with approximate melting points.

A readily-fusible, brazing alloy may be made with 46 per cent copper, 50 per cent zinc, 2 per cent tin, and 2 per cent lead. Brazing alloys containing much tin and lead should be avoided, since these mixtures penetrate between and surround the brass crystals, thereby decreasing the strength of the joint. For brazing soft brass, a silver solder of low fusibility can be used to advantage. An alloy consisting of copper, 24 per cent; silver, 24 per cent; and zinc, 52 per cent, is useful for delicate brazing operations.

In making brazing alloys it is important that the

Table II—Composition of Brazing Alloys for Various Metals

Metal To Be Brazed	Approximate Composition Copper	Zinc	Characteristics	Variety	Melting Temperature Deg. C.	Deg. F.
Iron and steel...	66.4	33.6	Very strong	Hardest	918	1,684
Monel and nickel	63.0	37.0	Very strong	Very hard	908	1,666
Copper.....	60.0	40.0	Strong	Hard	890	1,634
Copper and brass	50.0	50.0	Medium	Medium	880	1,616
Copper and brass	41.0	59.0	Fairly fusible	Fine	840	1,544
Thin brasswork..	33.0	67.0	Easily fusible	Very fine	803	1,477

constituent metals should be commercially pure, since impurities interfere with the color, malleability, and strength of the brazing metal. These alloys should be free from aluminum, antimony, or arsenic, and, as indicated above, tin and lead are injurious elements to employ where great strength is necessary. Brazing spelters or solders are commonly used in granulated form, and the usual sizes made are 00, 0, 1, 2, 3, 4, and 5, the 00 being extremely fine, and generally used with an atmospheric blowpipe or blowlamp flame. When the copper content exceeds 60 per cent, the brazing alloy is usually supplied in the form of strip or shot.

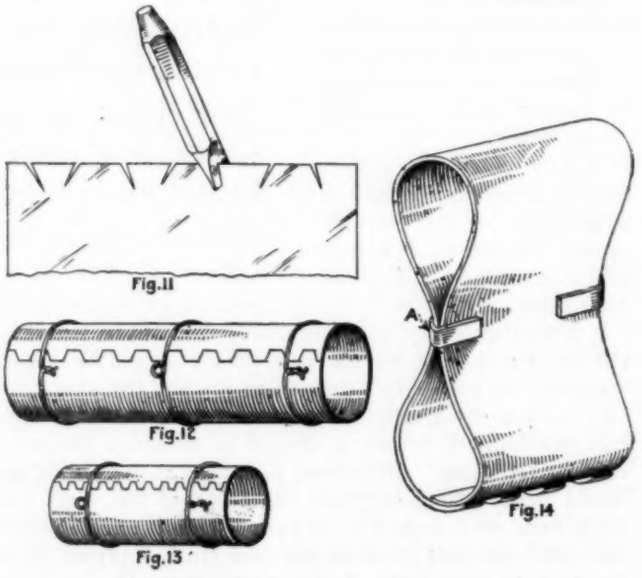


Fig. 11—Cutting the dovetails. Figs. 12 and 13—Dovetail joints ready for brazing. Fig. 14—Large work ready for brazing

Generally, it is much more satisfactory to purchase brazing metals than to make them, but when ordering, the use for which they are intended should be specified so that a suitable alloy may be obtained. There are, of course, brazing metals having other percentage compositions than those given in Table II, but those tabulated are quite sufficient for all ordinary purposes.

In Table III the colors and approximate temperature of heated metals are given.

Table III—Temperature Colors

Color	Deg. C.	Deg. F.
Faint red	515	960
Dull cherry red	700	1,292
Cherry red	900	1,652
Bright cherry red	1,000	1,832
Orange red	1,100	2,012
Orange yellow	1,200	2,192
White heat	1,300	2,372
Bright white heat	1,400	2,552
Brilliant white	1,500	2,732

A brazing metal that is required to withstand a dull, cherry-red heat (700 deg. C.) must necessarily have a fusing point above that temperature, but if the material is required to be used in brazing joints on sheet brass work, it must have a fusing point lower than 920 deg. C., since that is the melting point of ordinary brass (half yellow and half red). It will be seen that the brazing alloy for this metal must have a fusing point between 700 and 920 deg. C. In Table IV is given the composition of various brasses together with their approximate melting points.

Table IV—Composition and Melting Points of Various Brasses

	Approximate Composition				Melting Point	
	Copper	Zinc	Tin	Lead	Deg. C.	Deg. F.
Red brass	85	5	5	5	970	1,780
Low-grade red brass	82	10	3	5	980	1,795
Half yellow and half red	75	20	2	3	920	1,690
Yellow brass	67	31	...	2	895	1,645
Naval brass	61.5	37	1.5	..	855	1,570

The melting points given are where the alloy is completely molten. The temperatures are believed to be accurate within plus or minus 10 deg. C., or plus or minus 20 deg. Fahrenheit.

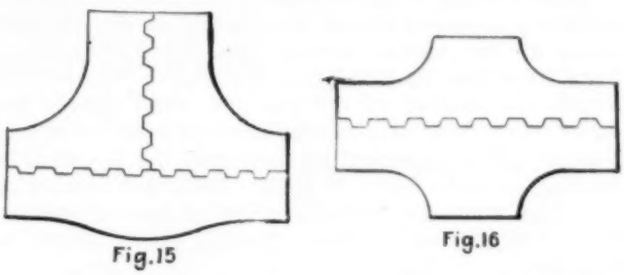
The melting point of brasses varies according to the percentages of their constituents, being generally closely approximating to the mean melting temperature of the constituents. Thus, while the mean melting temperature of copper is near to 1,085 deg. C., and that of zinc 420 deg. C., the melting point of a naval brass, consisting of 61.5 per cent copper, 37 per cent zinc, and 1.5 per cent tin, is approximately 855 deg. C. In a general sense, the color of brass is yellow, varying in shade according to the proportions of copper and zinc. It is harder than copper and, according to the composition, has considerable tensile strength.

The essentials of a brazed joint are contact of absolutely clean surfaces, free from oxide, dirt, etc. "Well cleaned is half brazed" is a true saying, hence too much care cannot be taken in preparing sheet metal parts to be joined. While it is possible to boil or burn out the dirt in a joint, it is not to be recommended, for the result is generally unsatisfactory. Preferably, the cleaning process should be a mechanical operation, that is, filing, grinding, or scraping, or better still, sandblasting. The latter method not only takes off scale, oxide and dirt, but it leaves the treated surface full of cavities, which make it suitable to receive the brazing metal.

If the work to be brazed is very greasy, it should be put in a vat of lye and allowed to remain for a few minutes, so that all traces of oil or grease will be removed before commencing the mechanical process of cleaning.

In the actual brazing operation, a flux is absolutely necessary in order to remove the oxides produced under brazing temperatures, and to allow the brazing metal to flow freely into place. The best and most reliable flux for brazing sheet metals, is pure borax. Some mechanics simply crush the lump borax into a fine powder, and apply it to the joint to be brazed. Others mix equal quantities of powdered borax and brazing spelter together in clean water, and apply the mixture. In the latter case, a little powdered borax is generally held in reserve to be thrown on the work, if needs be, in order to facilitate the fusing of the brazing alloy.

It is always best when using borax, to have it calcined, since calcining prevents it from swelling and frothing, as well as carrying away the brazing spelter



Figs. 15 and 16—Three- and four-way pieces jointed for brazing

when the heat is first applied. Calcining may be done by applying a bunsen flame from a blowpipe or blowlamp upon the borax, when it will swell up. It can be rubbed down after it has cooled. Borax treated in this way is much easier to use.

The most common brazed joint for sheet brass, copper, iron and steel, is the dovetail, thinned-edge joint. In this joint the edges of both pieces of metal are thinned by hammering, but only one edge is cut, as shown at *A* in Fig. 10, to form the necessary cramps. Cutting is done, preferably, by a sharp chisel or a strong knife held at an angle as shown in Fig. 11. The dimensions of the cramps are dependent on the size of the work. This method of cutting, insures that when the cramps are hammered down, there will be no thick edges at their sides, and that the joint can be made perfectly flush and of the same thickness as the rest of the work. For a straight joint on circular work, the cramps are bent up right and left alternately to allow the thinned portion of the other edge to go in as far as possible between them, and so that alternate cramps go on opposite faces of the thinned edge. When the edges are fitted together, the work is usually bound with iron wire, twisted tightly (see Figs. 12 and 13), so as to keep the cramps well in and to keep the joint securely in position during the brazing operation. The cramps are closed down with a mallet or hammer, on an iron stake or mandrel.

In brazing a side joint on circular work of fairly large dimensions, care should be taken not to allow the brazing metal to run away from the joint. To

avoid this, the brazing metal should be placed solely along the joint. In railroad-shop practice the method usually adopted to keep the brazing material to the joint on this class of work, is to bend the body of the object as shown in Fig. 14. The sharp radius at the joint insures the brazing metal running along the joint only. To keep the work in position during the brazing operation, it is advisable to fasten it with clips or clamps as shown at *A*. After brazing, shape the metal to its requisite form. When a piece of work is ready for brazing, place the brazing metal evenly along the joint with a spatula. Two or three spatulas, in lengths ranging from 12 to 24 in., will be found very useful when brazing longitudinal joints of varying lengths.

Place the work on a clean fire and heat up gradually at first, then braze on the fuel that has been blown up to incandescence beforehand. The flame should surround the work during heating, so that outside air is excluded as far as possible, to prevent excessive oxidation. When the brazing alloy has run through the joint and fastened the cramps on the outside, it is an indication of a good brazed joint.

When making a joint between two different metals, the flame employed should play mainly on the one that melts at the higher temperature, the lower-melting metal receiving its heat from the other. This method avoids the danger of melting one metal before the other reaches the brazing temperature. The source of heat should be continued long enough only to cause the brazing metal to flow into place. Prolonged heating of any sheet metal can do nothing but oxidize and weaken it, and this practice should be avoided as much as possible.

In actual brazing, it is important to remember that the heat must not only be sufficient in intensity but in amount. In the modern brazing hearth, the required heat is supplied by the combustion of air and coal gas, in conjunction with two movable-swivel blowpipes. Another very satisfactory method for brazing sheet-metal work, is the acetylene-air combination. Acetylene for brazing purposes provides a fuel that has an exceedingly high-flame temperature and high-calorific value. In addition, acetylene being a gas of a density approximately equal to that of air, the two can easily be mixed so as to yield a clean and relatively small flame. In Table V the comparative temperatures and heating values of coal gas, hydrogen, and acetylene are given.

Table V—Comparative Heating Values of Coal Gas, Hydrogen, and Acetylene

	Approximate Calorific Value of Fuel Gases B.t.u. per Cubic Foot	Flame Temperature in Deg. C With Air	With Oxygen
Coal gas	575	1,600	2,000
Hydrogen	279	.....	2,300
Acetylene	1,456	2,500	4,000

An acetylene-air blowpipe gives the correct degree of heat and may be regulated to give a clean and easily controlled flame. When brazing small parts, such as metal stampings, a distributed flame is required that will heat the whole of the work under treatment. For operations of this class, a tip is provided with a multiple orifice, giving a high-velocity, central jet, surrounded by jets for heat distribution.

Excessive use of flux should be avoided, especially toward the end of the brazing operation, otherwise the work will have a very hard surface. Generally, when a piece of work has been brazed, it is best to let it get cold, and not attempt to remove the surplus brazing spelter while it is hot, since by so doing it is apt to disturb and spoil what would otherwise be a sound joint. It is the practice, however, in some shops to remove the surplus metal and scale immediately upon completing the brazing operation, by vigorously scraping and

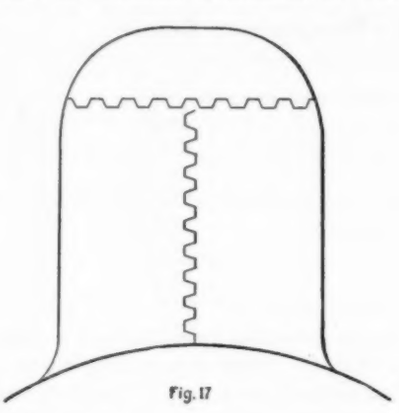


Fig. 17—Brass cover for a locomotive dome. Made from two pieces. Fig. 18—Steam pipe to have flanges attached by brazing

brushing the brazed surfaces, so as to reduce the final cleaning to a minimum. In the actual operation of brazing, joints will often appear to be sound, but when the surplus spelter has been removed it will be discovered that this surplus is what held the pieces together. When the extra material is cleaned off by filing, grinding, etc., defects caused by the brazing metal not having run into the joints satisfactorily, can be detected.

In Figs. 15 and 16 are shown good, practical methods for dovetailing and jointing a three-way, and a four-way piece. In Fig. 17 is shown a cover for a locomotive dome, made from sheet brass in two pieces. In Fig. 18 is shown a steam pipe of a locomotive. The work is slung vertically preparatory to brazing the flanges. Generally, a little clearance is allowed for the brazing metal to run in the hole, and the end of the pipe is slightly tapered. In some cases, the end of the pipe is worked over on the front of the flanges by a hammer. The heat from the hearth fire sometimes has to be prevented from going up the pipe, by filling it with a plug of wood, or with an iron disk luted with fireclay. Not infrequently, a covering of fireclay is placed on the tops and bottoms of the flanges, to protect them from the fire during the brazing operation.

Railroad shop men are required to know about many more kinds of machinery than formerly. Steam locomotives are becoming larger and more complicated, with boosters, superheaters and other appliances. Then there are the electric locomotives on the one hand and the new gasoline motor cars on the other. It may not be long before many railroad shops will have a "garage" department to handle gas engine repairs.

Always have blocking or backing directly under clamps in clamping work on machines.

Ideas from Practical Men

The department, "Ideas from Practical Men," is devoted to the exchange of information on methods useful to the machinery industries. Its scope includes all divisions of the machine building industry, from drafting room to shipping platform. Descriptions of methods or devices that have proved their value are carefully considered, and those published are paid for. The rates are from five dollars upward, according to their merit

Planing a Tapered Hole

BY R. W. STEWART

Some time ago we received an order for a two-piece mold with which to make a tone arm for a radio loudspeaker. This size and shape of the cavity may be observed in Fig. 1, which is a drawing of one-half of the mold. We had no means of boring a tapered hole of this size and shape, so we proceeded in the following manner.

The stock was planed to size and the two pieces were doweled together, after which the ends were carefully centered, the job placed in centers in a lathe and each end turned back far enough to give a bearing for a steadyrest. The job was then swung up by placing one of the turned shoulders in the chuck, with the other end carried in the steadyrest, and bored out to the size and shape shown in the drawing; reversing the position of the piece to bore the opposite end. The dotted lines *A* and *B* show the extent of the boring.

Pieces were turned to fit each of the bores, a good husky center drill being used to make the outer centers, and these pieces were drilled and tapped so that they could be bolted firmly to either of the pieces that were to form the mold. A piece of steel 1¼x2½ in. in size, was drilled near each end to accommodate the posts *C*, *C*, Fig. 2, through which pass the center points, one of which is fixed and the other adjustable. The piece to be planed was mounted on the centers of the device and the device itself placed in the vise of a shaper as in Fig. 2. The work was lined accurately in a horizontal plane with the travel of the shaper ram and tilted in a vertical plane so that when the tool was fed down it would just touch the surface of the short finished bore at either end of the taper.

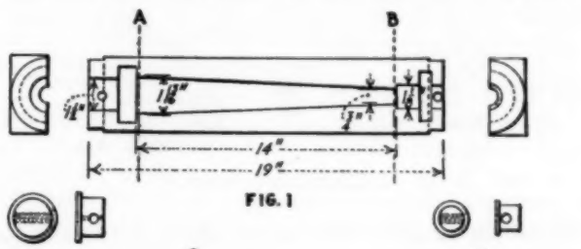


FIG. 1

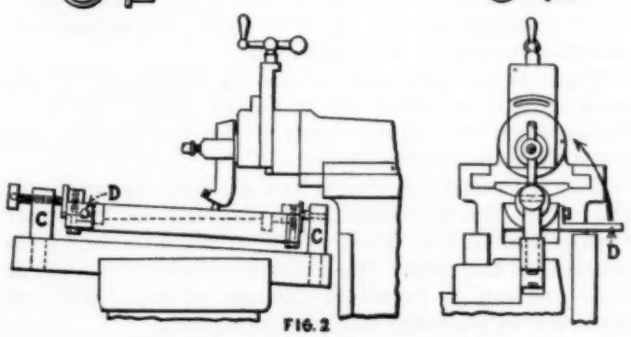


FIG. 2

Fig. 1—The taper hole to be planed
Fig. 2—The job mounted in the shaper

The feed was provided for by the bar *D*, by which the work was rotated slowly about its center. With a straight toolholder in the toolpost, about one-third of the semi-circumference could be finished. For the remainder it was necessary to substitute first a right- and then a left-hand offset tool so as to avoid interference with the surface.

Proper Analysis Results in Both Accuracy and Cheapness

BY W. B. GARDINER

A poor or imperfectly carried out analysis of the method of doing a job often results in considerable losses, since the cost, not only of the piece itself, but also of all the attendant tools, jigs, fixtures, gages and special machines, depends upon the selection of the proper procedure. Hence the job analysis should be thorough, since the cheapest and most accurate method does not always appear to be so.

An example of such an analysis is given below, in the slotting of the shell of the adjustable reamer shown in the illustration.

There is a straight axial hole of three diameters through the center of the piece. Cut central with this hole, on the left end, are two shallow radial slots which fit the driving key in the arbor. The six slots for the reamer blades do not cut through into the center hole until ⅛ in. back from the front end, which leaves a band of metal tying the front end together, strengthening the shell.

The end of each slot at *B* must be square with the axis of the center hole, and the slots must be of equal length. The front of each slot at *C* must also be square with the axis, but not necessarily as accurate as at *B*. The slots are radial and evenly spaced and must be of exact width. The reamer will not function or assemble properly unless all the points stated above are correct.

The original layout of the operations for finishing the slots was:

1—Mill to exact width. (Single-spindle fixture.)
2—Square ends. (Special machine.)

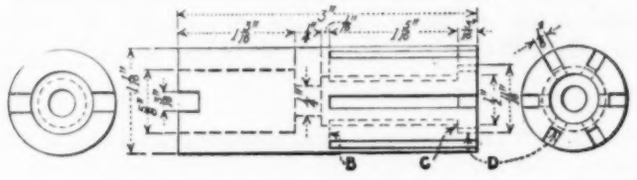
The revised method was:

1—Mill slots. (Multiple-spindle fixture.)
2—Rough finish slots to length and finish to width. (Broaches.)
3—Finish square ends. (Special machine.)

The slots were made with a horizontal cut to the depth

of *D*, then with a vertical feed they were cut through into the center hole with all the stock possible removed. Each slot was completed before indexing to the next one.

In the original layout a cutter of the final width was used with a single-spindle fixture. Undoubtedly, the extreme accuracy demanded in the width of the slots was largely responsible for the use of the single-spindle fixture; yet the character of this milling cut precluded any possibility of accurate milling to width in one cut,



The subject of the analysis

without a heavy loss due to wide slots. Aside from these losses, the process was so slow that the cost was prohibitive.

In the revised method, the milling cut was made in exactly the same way, but a multiple-spindle milling fixture and a gang of cutters, each one about 0.003 in. undersize in width, were used. Since these fixtures were strong and as the cutter arbor was rigidly supported, seven pieces could be milled at once without any loss, and in faster time than one had been finished in the old way.

In both methods, a large amount of stock remained after milling, which had to be removed in order to square the ends. In the old method, this stock was all removed in the special machine, but in the revised way, broaches were introduced first. They lengthened and squared both ends of the slots as close as was practical and finished the slots to the correct width.

The broaches passed completely through the shell, thereby finishing two slots at each operation. The entering part, or pilot, which was equal in size to the milled width of the slot, passed completely through the shell before the teeth for widening to the finished width entered. As these teeth passed through, a guide, or pilot, of the finished width at the rear, steadied the tool until the teeth were entirely through. The teeth for removing the surplus stock and squaring the ends were on the entering pilot and, therefore, all roughing was completed before any finishing to width was started.

The broaches were quite expensive, but there was no actual operation cost, since the work was done by the tender of the squaring machines while his machines were working. Despite their fragileness the broaches stood up well and did good work. They cut a large slice from the time formerly needed by the machines to square the ends. The upkeep of the machines became less and the life of their special tools, which were also quite expensive, became much longer.

Any small amount of fitting for width, necessitated by the stock springing when broaching, together with the finishing of the extreme front ends not finished by the broaches, was done to standard gages at the assembling bench.

This revised method of procedure gave a low manufacturing cost and maintained the high degree of accuracy necessary for proper functioning and interchangeability without scrap and without an undue amount of care. A proper analysis in the first place would have shown these facts and prevented loss.

Using a Hand Reamer in a Lathe—Discussion

By Philip F. Shafran

In the article under the title given above, on page 290, Vol. 64, of the *American Machinist*, H. S. Steele offers some very good arguments against the practice, or, rather, the malpractice, of using hand reamers in a lathe. However, I do not agree with his remark that "hand reamers should *not* be used in a lathe." Rather, let us say, "hand reamers should not be used in a lathe with power drive."

I believe that the best method of reaming a hole that has previously been bored, is to lock the spindle of the lathe with the backgears and rotate the reamer by hand, either with a reamer holder or by means of a dog that is clamped to the shank of the reamer; the reamer being guided by the tailstock center. The tailspindle screw is used to feed the reamer into the hole. This method is superior to reaming in a vise, since no skill is required to guide the reamer straight, hence there is less danger of an oversize or chattered hole.

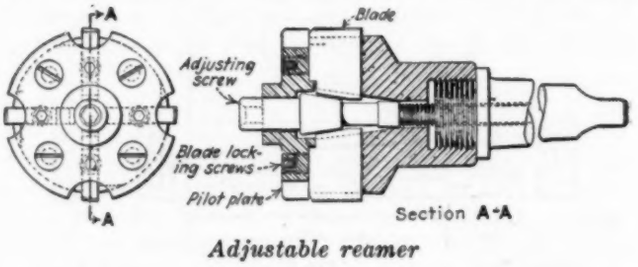
Another very good way to ream a hole by the above method is to allow the tail of the dog to rest upon the toolblock and to pull the belt with one hand while feeding in the reamer by means of the tailspindle screw with the other. The writer has used both of the above methods upon the lathe, and, with modifications, upon the milling machine, and has found them to be very satisfactory.

Adjustable Reamers with Interchangeable Blades

By A. W. Freeman

The illustration shows an adjustable reamer that was designed for reaming the open ends of gray-iron gas-engine pistons.

We have since found the tool to be very satisfactory for other production jobs and have made several sizes. The dimensions of the blades are the same on all sizes



Adjustable reamer

except for length. The sketch shows only four blades but the number can be varied to suit. The adjustment is approximately $\frac{1}{4}$ in. in diameter.

There is an advantage in making the blades of the same dimension other than length, since the worn blades from the larger reamers can be used as new ones in these smaller sizes.

The adjustment is simple and accurate by means of the center screw, which has a bearing on the inner ends of the blades. The locking screws hold the blades securely in the slots. The shank screws into the reamer body and can be varied or changed to suit. The end plate can be hardened and used as a pilot.

This type of tool is especially suitable for reaming short, open-end holes, $2\frac{3}{4}$ in. in diameter and larger.

Characteristics of Alcumite

Alcumite is an aluminum bronze alloy having malleable qualities of a high order. It has a high tensile strength and is resistant to corrosion. It will resist sulphuric acid in solution under 60 deg. Bé., and as high in temperature as the boiling point. Its chief applications are for pumps used in acid manufacture, stills, pickling baskets and tanks, valves, and ventilating equipment for handling fumes from such gases as chlorine, hydrogen sulphide, methane, oxygen, sulphur-dioxide, and hydrogen. The slight deterioration of Alcumite under the action of acids is shown in Table I.

Alcumite has a copper base with determined percentages of aluminum, iron, manganese, and nickel. The composition is varied depending upon whether the alloy is to be used for castings or for forgings. The physical characteristics of the common commercial Alcumite are given in Table II.

The alloy is not furnished by the makers in ingots, but is commercially available in castings, sheets, rods, or as stock bolts, rivets, washers, and wire. Alcumite may be forged, sheared, punched and machined almost as readily as medium carbon steel. The cutting speed is approximately 80 ft. per minute. There is a tendency to burnish the cutting tool as with other aluminum bronzes, but this difficulty is obviated by giving the tool plenty of clearance and keeping it sharp. Spinning and drawing are possible to an unusual depth, but a long time element must be observed.

Alcumite is readily forgeable, but requires a somewhat different treatment than either steel or other non-ferrous metals. The power required for rolling it is 40 to 50 per cent in excess of that needed for a corresponding reduction of carbon steel, but it can be rolled into shapes or drawn into wire as small as 0.005 inch.

The rod and sheet billets are usually sandcast. The possibility of pouring clean castings is here demonstrated by the fact that scalping or machining prior to rolling is usually unnecessary. Most of the rolling operations are performed at a temperature of approximately 1,600 deg. F. It is imperative that the billets be thoroughly soaked and brought up close to this temperature to insure good results.

It is ordinarily a very difficult matter to prevent porosity in making castings of aluminum bronze. For Alcumite, this has been largely overcome, however, through development of the alloy itself and through working out a special foundry practice. Castings, when correctly designed can be poured to withstand a hydrostatic pressure of 1,000 lb. per square inch.

The design is an important factor, considering the comparatively high shrinkage and the tendency toward rapid setting from the molten point even when poured at about 2,150 deg. F., the correct pouring temperature. This setting begins to take place at approximately 1,850 deg. F. It is a good policy, in connection with the design, to follow accepted aluminum practice. The castings should be as nearly uniform in thickness as possible, and where it is necessary to change section, the change should be gradual. Bosses, heavy ribs and other characteristics of design that involve unusual volumes should be avoided.

To insure pressure-tight castings, it is advisable to keep the minimum section at ⅛ in. or thicker. Castings with this minimum section extending for distances that would require the metal to flow through the mold for any considerable length is not best practice. The molten metal, as it flows, has a tendency to form oxides which are apt to result in segregation of dross and in consequent porosity. In some instances it is advisable to change patterns that are submitted for castings in order to provide for gating that will insure an adequate flow of metal into the body of the mold.

Table I—Corrosion Tests
All Tests at 80 Deg. Centigrade

	Concentration	Loss in Inches per Year
Sodium Chloride	26.5%	None
Zinc chloride	82.0%	.00195
Nickel sulphate	38.1%	.0125
Sodium carbonate	17.6%	None
Oxalic acid	8.8%	.035
Boric acid	Saturated	.0016
Aluminum sulphate	Saturated	.0024
Barium chloride	Saturated	None
Acetic acid	Concentrated	.0172
Potassium hydrogen tartrate	0.37%	.0158
Lactic acid	Concentrated	.0087
Magnesium chloride	34%	.0057
Tartaric acid	53.5%	.0048
Zinc sulphate	30 %	.0001
Citric acid	67.5%	.01169

Table II—Physical Characteristics of Alcumite

Secific gravity	8.3
Weight per cubic inch, cast	.30 lb.
Melting point	1900° Fhr.
Coefficient of expansion per one degree Fahr	.00000935
Thermal conductivity, B.t.u. per sq.ft., per degree Fahr. difference in temperature	48
Electrical resistivity, michrohms per cubic centimeter	18.6 (or 112 ohms per circular mill ft.)
Electrical conductivity	9% of copper
Shrinkage, inches per foot	3/16
Brinnell hardness:	
Castings	130
Hot rolled sheets	195
Hot rolled, annealed	141
Ultimate tensile strength, lb. per sq.in.:	
Castings	75,000
Hot rolled	110,000
Hot rolled, annealed	90,000
Percentage elongation in 2 inches:	
Castings	30%
Hot rolled	10%
Hot rolled, annealed	25%

At the present time, two grades of Alcumite sheet are produced. Grade "G" can be annealed by heating to a temperature of 1,450 deg. F. and then quenching it in water. Grade "D" can be annealed by heating to about 1,500 deg. F. and then cooling it slowly. This latter grade is best adapted for deep drawing and forming.

After a little practice, the metal can be welded with the use of regular Alcumite welding sticks and flux. The welding sticks are made either from special cast welding rods or from special cold-drawn Alcumite wire, or from strips sheared from the sheets.

For the information given we are indebted to the manufacturer.

Practical Shop Problems

Questions of a Practical Nature will be answered in these columns

Planed Machine Bases

Q. During the past few years the company with which I am connected has spent a good many dollars for new machines. These have been placed on hardwood floors in a new building. With the single exception of one make of lathe, none of the new machines have been planed on their bases, a fact that has occasioned a considerable amount of annoyance and additional expense to us. Please tell me why the bases are not completely machined, as I believe they should be.

A. It is our belief that the principal reason for not planing a machine-tool base is that the additional expense of finishing was thought unnecessary, because there are so many installations where the machines are grouted in the floor.

We understand that it is customary to specify this finish when it is desired, and believe that the work is done by the machine-tool builders at no cost, or at a figure which is made just large enough to cover the expense of the actual work.

Most factory floors are so uneven or out of level that, whether the bases are planed or not, it is a very good policy to line up and level the machine table or other working surface and then see that solid support is built up underneath at all points. Many machines are handicapped in first-class performance due to neglect of this important point.

Lubricating Sliding Surfaces

Q. We are developing a new machine which involves the use of a cast-iron platen that will slide on two cast-iron surfaces, and lubrication between them is one of our important problems.

We have referred to an article by A. L. De Leeuw which appeared in the "American Machinist." It was entitled "Methods of Machine Tool Design," and dealt with the subject of lubrication. If Mr. De Leeuw has gone any further on this subject as to filtering the oil and as to forcing it between the surfaces, we shall appreciate having his advice.

A. We have referred your inquiry to Mr. De Leeuw, and give you the following suggestions as he outlined them to us:

There are few precautions to take, outside of those mentioned in the original article, in order to get the lubricant between the working surfaces. The pressure under which the oil is introduced depends on the pressure per sq.in. between the two sliding surfaces, and should, of course, exceed this pressure by a small fraction. The pump to be used will probably have to be a geared pump, because with the small amount of lubricant required a centrifugal pump large enough to give the pressure required would be many times too large for the required volume. A geared pump naturally requires a safety valve or relief valve.

Another precaution is to provide for the oil a sufficiently large reservoir of which by far the greater part should be used as a settling tank. The overflow from the settling tank to the other part of the reservoir should be as wide as possible so as to give a broad, smooth stream of oil from one part of the tank to the other.

Another precaution that must be taken is to keep the oil in the machine constantly throttled—that is, one of the sliding surfaces must never uncover the openings through which the oil is introduced between the surfaces.

Extreme Accuracy in the Shop

Q. We have a request from an inventor for forty rollers 1¾ in. long. They must be 0.06200 in diameter for a distance of ½ in. from each end, and 0.0525 in. at the center. The requirements are that they be round and straight, and polished smooth, as a grinder finish would be too rough. He claims to have an instrument for detecting errors of a millionth of an inch, and wants to have the pieces that close. I have done work to one-tenth of a thousand, but no closer. Are the requirements practical?

A. If you have been working to one ten-thousandth of an inch you have been meeting the best standards of ordinary commercial practice. Anything closer than that borders on laboratory work. If the inventor's machine requires numbers of parts of infinite precision, he is likely to have trouble when placing it in commercial production. If the pieces are for roller bearings the most practical solution would be to buy from a maker of commercial roller bearings and accept their accuracy standards. You might put the requirements up to a maker of precision instruments for the tool room.

Re-rolling Boiler Flues

Q. We have welded the ends of the flues to the boiler head in our fire-tube boiler and now desire to know what we should use to re-roll them, as there are several leaks.

A. As far as the rolling operation is concerned, there are a number of companies that manufacture a good flue-rolling tool. If you expect to stop the leaks, however, you will probably be forced to close them with further welding, as the tubes cannot be re-rolled after they have been welded, to any good purpose.

The fact that you now have leaks is an indication that the welding has been poorly done and should be corrected. In this connection, patching over the present weld will not be successful, if the leaks are due to a burned steel in the weld. It will be necessary to first cut away all of the burned portion in order to get a satisfactory bond.

Technical Abstracts

Welding Aluminum

In the oxyacetylene method of welding aluminum, the welder proceeds as in the welding of steel, but stops after he has melted half an inch or so and stirs up the molten bath with an iron wire. In this way he breaks the oxide skin and allows the metal to coalesce. This method is not entirely satisfactory, however, because the oxide aluminum has a higher specific gravity than the metal and tends to sink to the bottom of the bath causing a considerable risk of oxide inclusions in the solidified metal. The method is also slow and very costly in gas and labor.

The most effective method of removing the oxide is by the use of a flux. A typical analysis issued by the British Engineering Standards Association calls for 45 parts of potassium chloride, 30 parts of sodium chloride, 15 parts of lithium chloride, 7 parts of potassium fluoride and 3 parts of potassium bisulphate.

All aluminum fluxes are hygroscopic and they must, therefore, be kept in an air tight box and stored in small quantities. They should be used sparingly and usually in the form of varnish on the welding rod. They have a corroding action on the metal and hence must be thoroughly washed off after the weld is completed. In welding aluminum alloys, the filling stick should be as nearly as possible of the same composition as the casting itself.—Edgar T. Painton in *The Engineer* (England), Feb. 12, p. 189.

Handling Men

Some of the many problems of leadership are to properly extend recognition for services well done, to extend help where it is needed, to give encouragement in adversity and to eliminate the unfit by just but not harsh means.

About every four months the supervisor should make comparative listings of his subordinates according to different qualities, such as ability to learn, quantity of work, industry, initiative, co-operativeness and knowledge of the job.

Every six months each man should be told where he stands in a frank manner. His shortcomings should be discussed. He should be told how to make himself worthy of a higher job, and if the limit of his possibilities has been reached, he should be told so.

A third suggestion is to give each man at this conference a chance to air his grievances. If the complaint is justified, it should be promptly adjusted. If the man is wrong, he should be told why.

Whenever there is a promotion or a wage adjustment, each man should be called in and told why before he discovers it through his pay envelope. Acknowledgment of merit extended without this talk loses its value as an incentive. Harold B. Bergen, manager, personnel department, Henry L. Doherty & Co., in *Industrial Management*, Feb., 1926, p. 88.

Outlook for the Diesel Locomotive

Diesel engines applied to locomotive service cannot start, as is necessary, at a practically zero speed, so the power must be transferred to the wheels in one of three ways, by means of mechanical, electrical or hydraulic transmission. The latter usually uses oil as a medium. The electrical is the most attractive method of transmission and the mechanical method, analogous to the ordinary stepped-gear system applied to automobiles, probably has only 150 hp. as a practical limit.

The thermal efficiency of the Diesel engine is about 3 to 1 over the steam locomotive. The weight of the Diesel locomotive per horsepower is greater than that of the steam units, being at the present time about 275 lb. per hp. The cost of construction of the Diesel locomotive is about twice that of the steam locomotive, and its cost of operation is also greater.

The Diesel engine has the advantage of eliminating ash pits and the handling of refuse. In terminal and tunnel operation, the Diesel engine makes unnecessary the cost of electrical installations.

Many experiments are being carried on to improve the practicability especially of the Diesel-electric locomotive, but it will be years before the steam locomotive, owing to its simplicity, its serviceability and its low production cost will be relegated to the era of the past. Samuel M. Vauclain, president of the Baldwin Locomotive Works, in *Railway Age*, Feb. 6, p. 388.

Buying Screw Machine Products

A better understanding on the part of the buyer of screw machine products as to what constitutes good commercial practice in the manufacture of such parts, and what procedure tends to increase the price or hamper the source of supply, would be to the advantage of both buyer and seller.

In making up the drawing it should be decided what dimensions should be worked to ordinary commercial tolerances, and what dimensions should have close tolerances. It is naturally inadvisable to hold the manufacturer to extreme accuracies where such accuracies are not essential for service.

It should also be borne in mind that it is not economical to make screw machine products when the quantity is relatively small, because the cost of tooling and the cost of setting up the machine will then be a very large proportional of the total cost and will have a direct influence on the price of the piece. Five thousand simple and sizable pieces is about the smallest number that can be made economically on an automatic screw machine.

The conditions under which screw machine products are manufactured on automatic machines are such that there is certain to be a small percentage of pieces not perfect. If the manufacturer is requested to make 100 per cent inspection before the goods leave his factory, he will naturally have to increase his price. In this case, if specifications and tolerances should happen to be very rigid, his percentage of rejections will be still higher and naturally his costs will be higher.—C. W. Bettcher, Sales Manager, Eastern Screw Machine Corp., in *The Iron Age*, Mar. 11, p. 688.

American Machinist

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Improving Government Purchasing

AFTER four years of work the Interdepartmental Board of Contracts and Adjustments has submitted the draft of a proposed bill to simplify and improve the archaic purchasing methods of the National Government. The new bill represents the first complete revision in 135 years. It is now in the hands of department heads to be studied and commented upon.

Apparently the most valuable part of the bill is the section repealing over fifty acts having to do with Government purchasing, some of them more than one hundred years old. Any legislation that relieves the statute books of some of the oppressive load of obsolete laws is welcome.

Most of the provisions in the new law are obviously sound but several merit considerable study. For instance, Section 8 on Opening Bids says, "The award shall be promptly made by written notice to the lowest and best bidder for the interest of the Government."

It frequently happens that the bid of the lowest bidder is not for the interest of the Government. If the law means that the lowest bid must get the order, why say anything about "best" or "the interest of the Government"? For if the interest of the Government is to be really considered, the "and" should be changed to "or."

Another questionable clause is in Section 16 which provides that no contract shall be given where work is required or permitted for over 8 hours in any one calendar day. While the object of this clause is good there are shops where the men prefer to work over 8 hrs. per day for 5 days in order to have Saturday free. The enforcement of this clause will compel the bidders to run the shops 6 days a week. Some provision should be made to cover such cases and still maintain the spirit of the law. Otherwise we shall see violations overlooked, which tends to decrease respect for all law.

The Farmer's Problem

WHY is the farmer slowly but steadily dropping behind in the economic race? According to a study made by the National Industrial Conference Board he is relatively not so well off now as he was twenty-five years ago.

It is pointed out that he buys in the domestic market where prices are high and sells both here and abroad against competition from other countries, where standards of living are lower. His expenses have risen faster than the prices he gets for his products. The need for careful study of the problem and the importance of getting a solution are apparent.

The answer is not going to be found in a minute but isn't this a factor in the situation—that the farmer's position corresponds quite closely to that of the one-man shop in industry, or the little store in trade? How many proprietors of one-man shops, or of little stores, are much better off than the average farmer? The big plants do the great majority of the business in every line in industry and the department stores, chain stores and mail order houses are crowding out the individual in the mercantile field.

Perhaps the solution of the farm problem lies in a study of the development of the large unit in the industrial and commercial fields. In any case no answer that is unsound economically can be considered final.

Shall the Tail Wag the Dog?

METRIC Bill HR-10 introduced into Congress on Dec. 7, 1925, by Congressman Britten has been aptly called "a bill to promote complications in the daily affairs of the Nation and to compel the use of a dual system of weights and measures." On its face the bill is mild and gentle and is only intended as an entering wedge toward future drastic legislation.

In view of the fact that the use of the metric system is already permissible the insincerity behind the bill is evident. When we compare the amount of machinery made and used by the nations using the English system and those using metric, any effort to compel the adoption of the metric system is another case of the tail trying to wag the dog. And if it succeeds, it will be an expensive wag for the dog.

Where Quantity and Quality Go Together

IN THE "good old days" we used to think that you had to choose between quantity and quality in building machines of any kind. Unless you took time to scrape bearings carefully and fit parts together, you didn't get a quality job.

The automobile shop has taught us differently. We now get quantity production, at unbelievably low costs, and of a better quality than ever before. Even the cheapest cars are of better quality than the expensive cars were 10 or 15 years ago.

We no longer scrape bearings or "fit" parts together, but we make them with such close tolerances that they go together and make a good job, without fitting. That's one reason why almost any small-shop man can pick up an idea or two from any automobile shop article.

Shop Equipment News

Le Blond Automatic Lathe Heavy-Duty, No. 16

The No. 16 heavy-duty automatic lathe shown in Figs. 1 and 2 has been placed on the market by the R. K. Le Blond Machine Tool Co., Cincinnati, Ohio. The machine is intended for either turning or facing or a combination of both and will do multiple cutting on such parts as wheel hubs, housings, sleeves, flanges, cluster-gear blanks and shafts.

The bed of the machine is of the double-shear type, as can be seen readily in Fig. 1. On its dovetail guiding shears are mounted the headstock and the tailstock, and the front and rear carriages. The carriages also have a bearing on the outer pair of broad flat shears. The bed is braced with heavy cross girths spaced so as to provide sufficient chip room without impairing its strength. The various bearing surfaces are designed to have a large area, in order to increase the rigidity of the machine. Adjustable gibs are provided to take up wear. The bed is a semi-steel casting. A heavy pressed-steel oil pan is furnished.

The headstock, a rear view of which is shown in Fig. 2, provides nine changes of speed from a constant-speed driving pulley. The driving pulley runs on an oil bush and is connected to the shaft by means of a multiple disk clutch running continuously in oil. Three springs embodied in the clutch not only separate the plates when the clutch is disengaged, but also apply a cone friction brake.

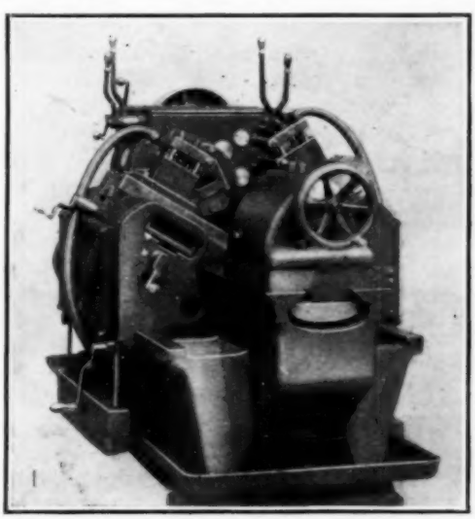
The range of spindle speeds is obtained by means of sliding gears controlled through two conveniently located speed-change levers. The gears are made from chrome-nickel alloy steel, heat-treated and hardened. They have stub-form teeth and they are rounded to insure easy sliding engagement. The sliding gears are mounted on short high-carbon shafts with six hobbed splines, the corresponding keys in the gears being broached from the solid metal. The spindle is a high-carbon, crucible-steel forging. The bronze spindle boxes are tapered, babbitt-lined and adjustable. The spindle nose is a large flange for the application of drivers and fixtures.

The tailstock is screw operated and is of the set-over type. It has a long bearing on the shears of the bed and is clamped in position by means of four bolts. The tailstock spindle is made of high-carbon steel.

The front and rear carriages each contain a cam drum and a system of cams, as can be seen in Fig. 3. The longitudinal movements of the carriages and the cross-movements of the facing slides are all derived from these cams. They are adjustable in their position. The drive to the cam drums is through a set of spur gears from a multiple-splined feed shaft at the front and at the rear of the bed. The drive to the feed shaft is from the headstock spindle through a system of gearing on the end of the head. Change gears provide for variation in the rate of movement of the cam drum. Standard cams or special cams for individual requirements can be supplied.

The carriages are kept in alignment by means of adjustable gibs. The carriages and the cross-slides are provided with rack and pinion movements for hand adjustment during the set-up. A crank is also provided for revolving the drums by hand while adjusting the cams in position. The facing slides are assisted in their return travel by means of suspended counterbalances. On lathes with long beds additional carriages can be furnished where the work will allow; several bed lengths are regularly supplied.

The front and the rear carriages, cam mechanisms and slides are identical in construction. The lathe



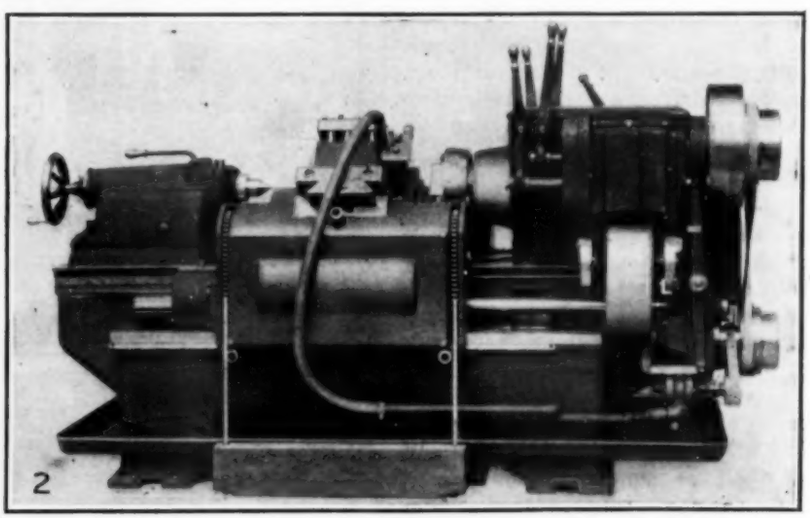


Fig. 1—Le Blonde Automatic Lathe, Heavy-Duty, No. 16. Fig. 2—Rear view of the machine

Shop Equipment News

can be operated from either the front or the rear, since duplicate sets of control levers are provided. The short lever controls the multiple disk clutch in the driving pulley, and the long lever engages an automatic spindle start and stop mechanism.

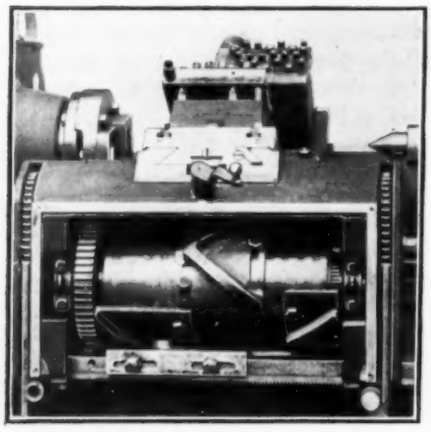


Fig. 3—The cam mechanism for the front carriage

The long lever also engages the feed and the traverse for the carriages and the cross-slides through the cam mechanisms. The function of the operator is simply to insert work and to engage the feed. It is claimed that one operator can handle three or four machines.

For plain taper turning an attachment can be furnished for either carriage. The taper attachment mechanism is built into the carriage housing and consists essentially of a guide bar and follower rollers. The guide is adjustable to any taper and can be replaced with special formplates for duplicating work that has an irregular contour. The longitudinal movements of the carriages are derived from the cam mechanism while taper turning. The maximum taper is 4 in. per foot.

The more important units of the machine are flood lubricated. Oil level indicators show the levels to which the various units are to be filled. The headstock is flood lubricated and by means of a submerged geared pump and piping, a cascade of oil is carried to all bearings in the gear train. A centrifugal coolant pump is regularly supplied. The flow of coolant is automatically shut off when the spindle is stopped.

A constant-speed geared motor drive can be mounted on the headstock. The drive is through the motor pinion and a micarta intermediate gear to the broad-faced gear that replaces the driving pulley. The entire train is inclosed with a cast-iron gear guard.

The swing of the lathe over the carriages is 16½ in. and over the facing slides it is 12 in. With a 7-ft. bed the machine will take 24-in. work between the centers. The maximum travel of the facing slide is 4½ in. and the maximum turning length is 7 in. The range of nine spindle speeds is from 16 to 103 r.p.m. The diameter of the driving pulley is 16 in., and its speed is 400 r.p.m. A 15-hp., 1,200-r.p.m. motor is recommended for individual drive. The machine weighs 7,400 lb.

"Pfauter" Automatic Gear Hobbing Machines, Improved

The line of "Pfauter" automatic gear hobbing machines, marketed in this country by the O. Zernickow Co., 15 Park Row, New York, N. Y., is being equipped in the larger sizes with a hydraulic table load-balancing device and several improvements have been made in the construction of the machines.

Spur, worm, helical and herringbone gears, sprockets, ratchets, circular saws and spline shafts can be generated on these machines, the No. 4 size of which is illustrated in Fig. 1. The main drive can be from a motor or from a countershaft to a three- or four-step cone pulley. Double back gearing for heavy work is provided on all but the smallest of the ten models. The hob drive is through transmission elements from the main shaft.

The cutterhead has been made of heavier construction. It has small overhang and can be swiveled to any degree from the horizontal to the vertical. A graduation is provided for accurate setting. The hob spindle bearing is adjustable sideways for accurate centering of the hob, and it has a scale and vernier. The hob spindle carriage slides on the upright column on wide, double V-shaped ways that have adjustable gibs to insure a tight fit. A counterweight located within the upright balances the carriage and the cutterhead.

The work table is of large diameter and it has a wide circular coolant channel. The used coolant runs through the channel back to the tank. The table has a flat horizontal bearing and adjoining this a conical

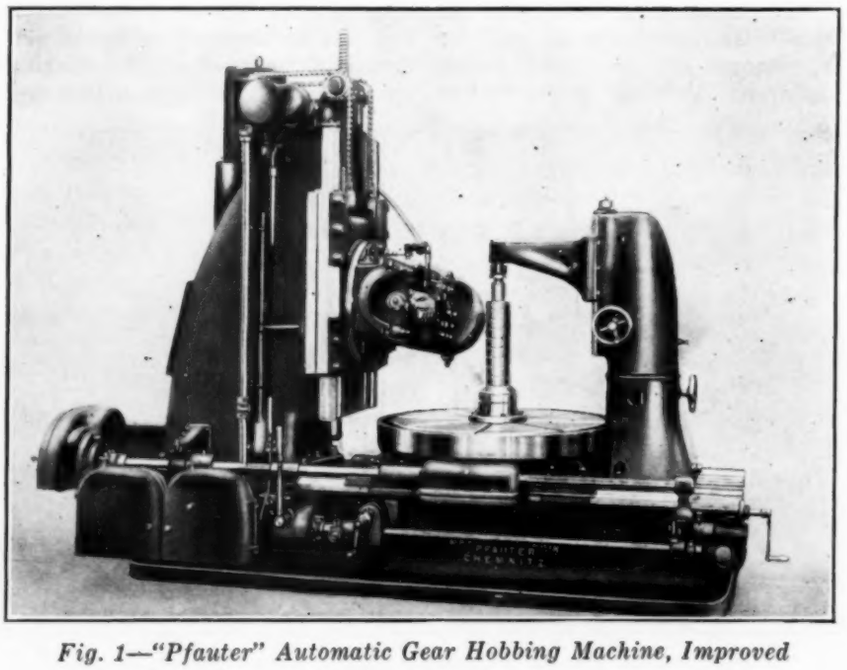


Fig. 1—"Pfauter" Automatic Gear Hobbing Machine, Improved

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bearing. A flat bearing on the bottom prevents the table from lifting and jumping.

On the No. 5 and No. 6 machines the weight of the large gear blanks is relieved by means of a hydraulic table load-balancing device, of which a drawing is shown in Fig. 2. The entire weight of the gear blanks and blank supports and three-fifths of the weight of the table are placed on

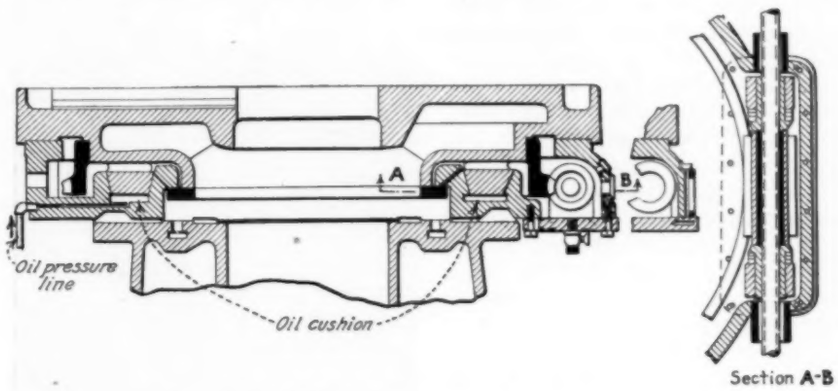


Fig. 2—The hydraulic table load-balancing device

an oil cushion to secure liquid friction. The remaining two-fifths of the table weight have mixed or semi-fluid friction as a result of the large bearing surfaces and the resulting small pressure area. In the space labeled "oil cushion" in Fig. 2, oil is forced by means of a pump. The pressure is read on a pressure gage and is regulated, according to the table load, by means of a throttle. A telescoping or flexible pipe line is provided to compensate for movement of the table base. A valve is placed in the line between the pressure gage and the table.

The table base slides on double V-shaped ways on the bed of the machine, and can be clamped in any position. The machines are provided with a measuring scale that has a vernier. The table screw also has a graduated dial for setting it to the depth of cut desired. Rapid power traverse in both directions is provided for the cutterhead and the table carriage on the larger sizes of machines. This mechanism is operated by means of a lever at the change-gear side of the machine.

Feed gears can be used to control the automatic feed. They actuate the vertical movement of the cutterhead or the automatic infeed of the table against the hob. Any feed can be selected to suit the conditions. The feed can be stopped automatically or by hand.

The index wormwheel is of large diameter and it is located close under the worktable. Fine pitch teeth are used to secure accuracy. The index worm is hardened and accurately ground to conform to the hob used in cutting the index wormwheel. The worm runs in a dust-proof oil bath. It is adjustably mounted to take up wear between the worm and the wheel. It is driven from the main shaft through index change gears, of which a set of about 40 is furnished as standard equipment.

The countershafts of all sizes have ring-oiled bearings and the loose pulleys have a slightly smaller diameter than the fast pulleys in order to relieve the stretch of the driving belts. Cast-iron gear guards are used throughout on the machine.

The upright of the machine is a hollow casting. Its base is bolted to the bed and held in position by means of tapered dowel pins.

The machines are built in ten sizes, Nos. 000, 00, 0, ½, 1, 2, 3, 4, 5 and 6. They require ¾, 1, 1½, 2, 3, 4, 6, 8, 15 and 20 hp., respectively. The maximum diameters of spur gears that can be accommodated by the machines are 4, 8, 13¾, 19½, 29½, 39¾, 59½, 87, 118 and 157½ in., respectively. The floor space occupied ranges from 17x29 to 98x216 in. Their weights are 690, 1,200, 1,700, 2,800, 3,600, 4,950, 12,000, 21,200, 41,800 and 82,000 lb., respectively.

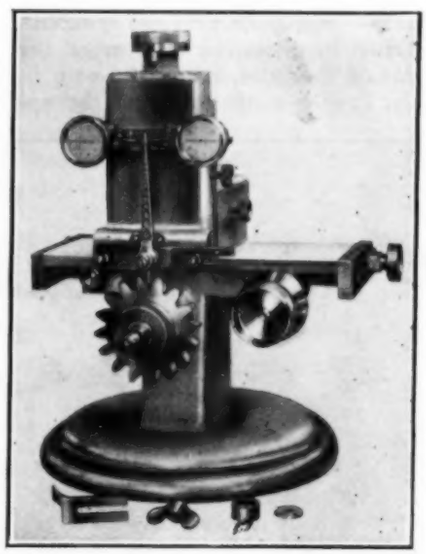
The machine generates true involute teeth, using hobs that have a straigh-line rack profile.

"National-Cleveland" Tooth Form Tester

In order to check the accuracy of both the tooth spacing and the tooth profile of an involute gear shaper cutter or a gear, the National Tool Co., Cleveland, Ohio, is building the machine illustrated. The gear or cutter is mounted on the spindle and held by the thumb-nut. The gear or cutter is set by the stop shown at the right of the tooth while the contact point on the lower end of the lever touches the tooth to be measured.

The indicating lever, with a 10 to 1 multiplication, is mounted on a slide that is moved by steel tapes from a pulley on the back end of the spindle that carries the gear being tested. Moving this slide by means of the knob at the right also turns the gear, and the contact follows the tooth form as the gear rolls in unison with the movement of the slide. Any inaccuracy in the tooth form is shown by the indicators at the upper end of the pointer.

The head carrying the indicators can be adjusted vertically to take



"National-Cleveland" Tooth-Form Tester

gears or cutters of different diameters. Micrometer graduations are provided for all movements. The machine is built in different sizes to measure gear shaper cutters of 3 or 4 in. diam. and in two sizes for Sykes herringbone cutters, the largest having a range up to 12 in. in diameter.

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Brown & Sharpe Automatic Duplex Milling Machine, No. 37

The No. 37 automatic duplex milling machine of the two-spindle manufacturing type has been added to the line of the Brown & Sharpe Manufacturing Co., Providence, R. I. The single unit type was previously described on page 602, Vol. 58 of the *American Machinist*. Since the machine is of the duplex type, its two uprights and opposed spindles permit the use of two face mills or two gangs of cutters working simultaneously. The machine is intended particularly for face milling operations or, by using cutters on the arbors, the piece can be milled both above and below at the same time. Fig. 1 is a front view of the belt-driven model, while Fig. 2 shows a rear view of the motor-driven type milling the top and the end of a piece.

The inside spindle rotates in one direction only at a speed determined by the change gears used. The outside spindle runs either forward or reverse at a speed also controlled by change gears. Its reversal is accomplished by throwing a lever at the base of the head, as can be seen in Fig. 2. On work requiring the use of only one spindle, the outside spindle can be set to remain stationary.

The drive for the machine is of the constant-speed type, so as to furnish independent spindle and table drives. Speed changes from both the spindle and the table are accomplished independently of each other. The spindle heads are mounted on uprights which are located one on each side of the table. Each spindle is provided with independent vertical adjustments. A separate set of change gears for each gives them independent speed changes. The upright mounting in the main spindle is cast as a part of the bed. The outside upright is adjustable and it is provided with a transverse movement of 7⅝ inches.

The No. 37 machine is equipped with full automatic table control. Both the fast travel and cutting speed of the table operate automatically in either direction, so that the machine is adaptable to this company's method of milling with a fixture at each end of the table. The movements include a constant fast travel, a variable cutting speed, reverse and stop. Any or all of the movements may be used during the cycle of operation and may be operated automatically by means of adjustable dogs located on the front of the table. The start, stop and reverse movements of the table are also controlled by means of a hand lever at each end of the saddle. Another hand lever on the left of the saddle controls the cutting speed and the constant fast travel.

In milling with a fixture on each end of the table, the machine is started, the work in one fixture is brought up to a point just before engaging the cutters at a constant

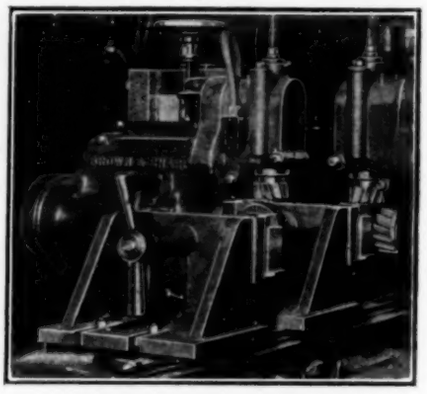
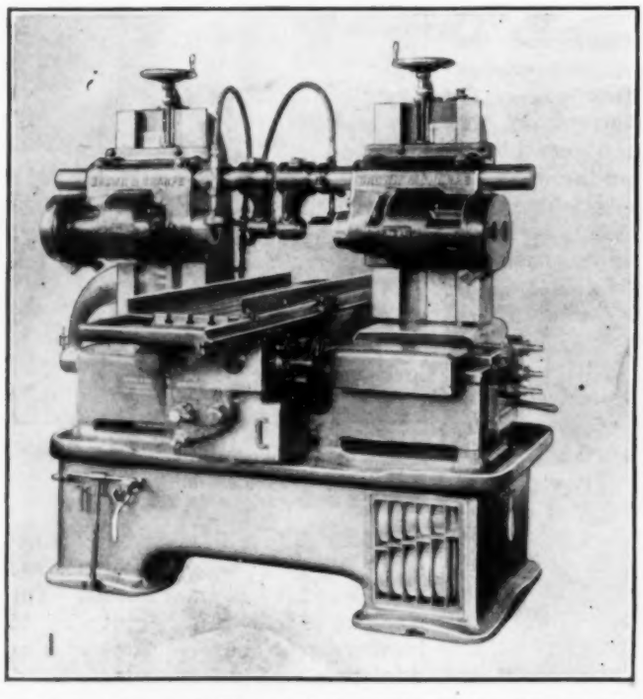


Fig. 3—Face milling in connection with the automatic table



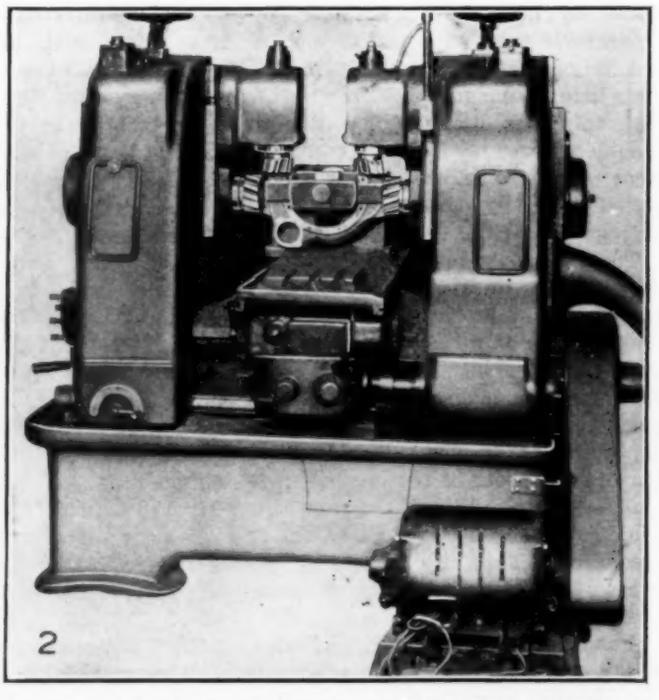


Fig. 1—Brown & Sharpe Automatic Duplex Milling Machine, No. 37. Fig. 2—Rear view of the machine showing the use of special vertical milling attachments and the motor drive

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fast travel of 210 in. per min., and the cutting speed is automatically engaged. At the completion of the cut the table is automatically reversed, the constant fast travel engaged and the work in the other fixture is brought up to the cutters where the foregoing cycle of operations is repeated. By means of this method the operator can load one fixture while work is being milled in the other. The machine can also be set to stop at any point in the cycle.

The general design of the machine is of a rugged nature so as to permit the use of special attachments. Multiple or angular heads, or simple horizontal and vertical heads similar to the one illustrated in Fig. 3, can be used where necessary.

Fellows Thread Generator, Improved

Improvements in the thread generator previously described on page 923, Vol. 58 of the *American Machinist* have been made by its builders, the Fellows Gear Shaper Co., Springfield, Vt. The principle of operation in both the former and in the present model are the same. The machine is now provided with a reversing and quick-return mechanism, and other features to increase the production of the machine and to simplify its operation.

The driving mechanism is now at the right-hand end of the machine, as can be seen in Fig. 1. The mechanism consists of a gear box and two pulleys. The larger pulley operates the drive for cutting while the smaller pulley acts as an idler and, through the quick-return gear box, furnishes the drive to return the cutterslide to the starting position. In Fig. 2 is illustrated a rear view of the machine showing the mounting for a motor drive.

The machine operates as follows:

After the machine has been set up with the work and the cutter in position, the operator moves the clutch lever away from him for right-hand threaded work. This lever can be seen at the inner end of the gear box on the left-hand end of the machine, in Fig. 1. This engages the clutch in the gear box. He then moves the belt-shifting lever to the right to shift the belt to the tight pulley. This lever can be seen to the left in Fig. 2 in an oblique position on the gear box.

The cutter then starts its work, provided the feed clutch has been engaged, and travels toward the left-hand end of the machine. The central of the three horizontal rods which can be seen in Fig. 2 carries a stop which is engaged by the cutterslide when the cutter reaches the end of its necessary travel. This rod is then moved toward the head of the machine and it lifts up the vertical rod which can also be seen in Fig. 2. The vertical rod in turn operates the trip lever at the top of the gear box and just above the belt-shifting lever. This trip lever throws the belt to the loose pulley and stops the machine.

The operator next raises the handle which can be seen near the cutterslide. This handle raises the cutter from the work. The operator

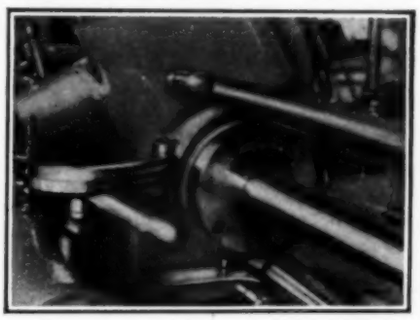
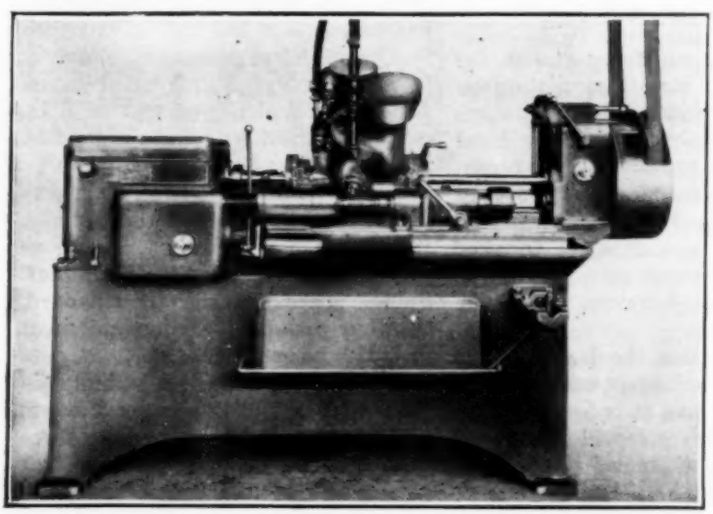


Fig. 3—Close-up view of the cutterhead

engages the quick-return mechanism by pulling the clutch lever towards him. The machine stops automatically when the cutter reaches the starting position. A new piece of work can then be inserted, the cutter lowered again and the machine restarted.

The differential mechanism which synchronizes the movement of the cutter and of the work as the latter is fed longitudinally has been simplified in the present model so that for cutting right- and left-hand threads no changes are necessary in the mechanism itself. To change the machine for left-hand instead of right-hand work, the position of the screw in the starting lever is changed



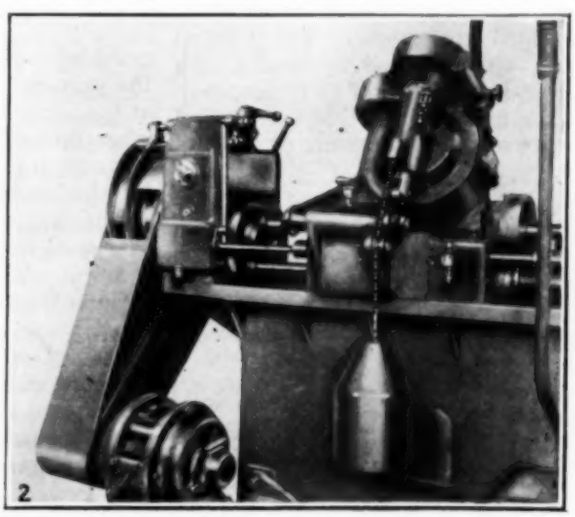


Fig. 1—Fellows Thread Generator, Improved. Fig. 2—Rear view showing motor drive

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and a split ring removed from or inserted in the cutterhead as shown in Fig. 3, which is a close-up view of the cutterhead. Helical gears are now used to drive the work spindle.

A clutch has been added so that the power feed can be engaged or disengaged as desired, for convenience in setting up the machine. This clutch is mounted on the shaft operating the feed gears which control the rate of travel of the cutter-slide along the bed. Three types of control mechanisms are provided for various depths of cut. A worm adjustment for setting the cutter to the proper depth is provided.

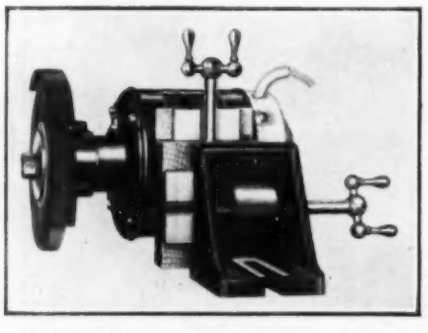
For individual motor drive, a bracket fastened to the rear of the bed carries a trunion upon which an additional bracket is held. The motor is fastened to this second bracket so that the pulley on the motor will line up with the two pulleys on the machine. The tension of the belt is taken care of through an adjustable setscrew.

Hisey-Wolf Double-Slide, Angle-Plate Grinder

The Hisey-Wolf Machine Co., Cincinnati, Ohio, has placed on the market the double-slide, angle-plate grinder illustrated. The unit is built around an electric motor designed and manufactured by the company.

An angle plate carries the horizontal slide which can be moved by means of a screw over a distance of 4¾ in. The horizontal slide in turn carries a vertical slide on which is mounted the motor. The vertical slide, also operated by means of a screw, has a travel of 5½ inches.

The grinding wheel is 8x¾ in., and it is protected by means of a wheel guard. The machine is equipped with ball and sleeve bearings. Either ½-hp., 60-cycle, a.c. motors or d.c. motors can be supplied. The a.c. motors are for 110-volt, single-phase; 220-volt, single-phase; or 220-volt three-phase current, and rotate at 3,400 r.p.m. The weight of the a.c. type is 68 lb. The regular d.c. motors are for 115- or 250-volt service and operate at 3,000 r.p.m. The weight of the d.c. type is 63 pounds.



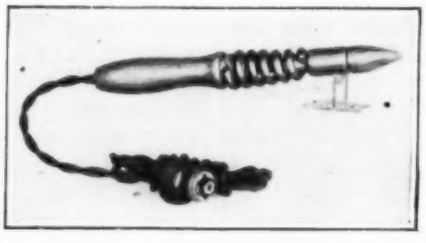
Hisey-Wolf Double-Slide, Angle-Plate Grinder

Other special motors manufactured by the company are made for operation on 80- to 440-volt a.c. current and from 40 to 60 cycles, also for two-phase service, and d.c. current of from 80 to 250 volts.

General Electric Soldering Iron

The General Electric Co., Schenectady, N. Y., is now marketing a soldering iron of light construction, designed to heat up quickly. This iron is made in standard sizes ranging from ½-in. to 1¼-in. tips.

The power consumption ranges from 70 watts for the smallest iron for light and intermittent use, to 350 watts for the largest size on heavy duty. The irons for heavy duty are



General Electric Soldering Iron

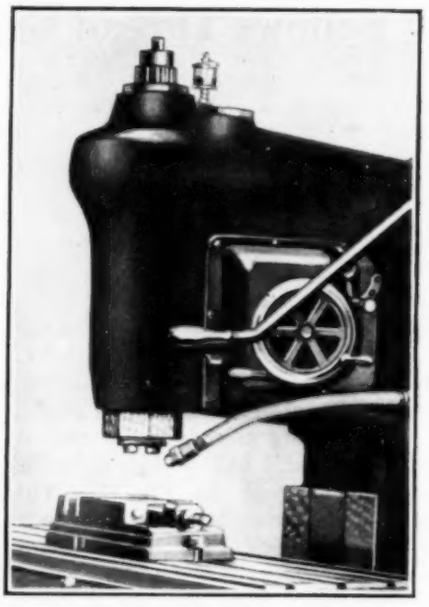
provided with radiating stands for the purpose of maintaining the iron at the correct operating temperature when temporarily not in use. Heat from the tip is prevented from reaching the handle by means of a special mechanical construction, consisting of a steel rod wound in the form of a spiral. This rod also provides a rigid connection between the handle and tip.

Instead of mica the heating unit has an insulating powder highly compressed so that it becomes a good heat conductor and will withstand temperatures of more than 2,000 deg. F.

The iron is provided with a standard lead and connection plug.

Kempsmith Vertical Maximiller with Adjustable Spindle

The Kempsmith Manufacturing Co., Milwaukee, Wis., is marketing a modified form of its standard vertical Maximiller with an adjustable spindle. This milling machine is designed for die sinking, tool making



Kempsmith Vertical Maximiller with Adjustable Spindle

and other work requiring accurate adjustment of the spindle.

The spindle is mounted in an octagonal quill and on account of the large area of contact no gibs are used. The upper end of the spindle has ten splines for the drive which is through herringbone gears, driven in turn through spiral bevel gears. A total vertical adjustment of 6 in. can be obtained with the two models, No. 2 and No. 4.

Two large bronze bearings are provided in the quill for the spindle, the speeds of which are the same as the standard vertical Maximiller. Spindle speeds 2½ times the standard, together with ball bearing equipment may also be specified.

Power feed to the spindle is through a screw driven by a worm and wheel and is supplied in three speeds, 0.005, 0.009 and 0.014 in. per rev. of the spindle. The feed is reversible and has a safety device to prevent overtravel. The hand feed

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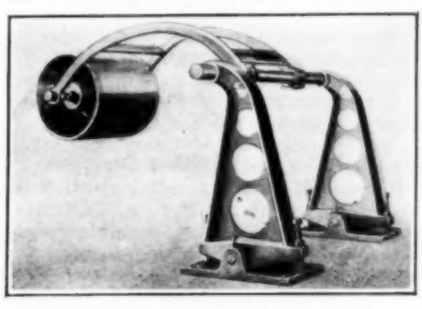
also has two feeds, 0.025 and 0.125 in. per turn, selected by means of a knob in the center of the handwheel. The spindle feed and speed controls are convenient to the operator's right hand.

The nose of the spindle and all other parts of the machine are standard vertical Maximiller parts.

Perry Tilting Idler-Pulley Stand

For use in connection with the "Beltslacker" manufactured by him, Harry M. Perry, 702 North Main St., Los Angeles, Calif., has placed on the market the tilting stand shown in the accompanying illustration. The "Beltslacker" or idler pulley is carried by means of a pulley bracket hinged at the top of the tilting stand. The tension on the slack belt is secured by the weight of the pulley and the arms.

Each stand consists of a base and a triangular tilting arm. The arm is mounted on a pivot at the center of its base. At each lower corner is a setscrew provided with a locking nut. Movement of the stand will regulate the distance between the idler pulley and the main driving pulley so that the idler pulley will be in a position where the belt on each side of it will be at the same angle from the vertical line. When the pulley is in this position there is less tendency for it to push or pull horizontally on the hinged bar. A belt can



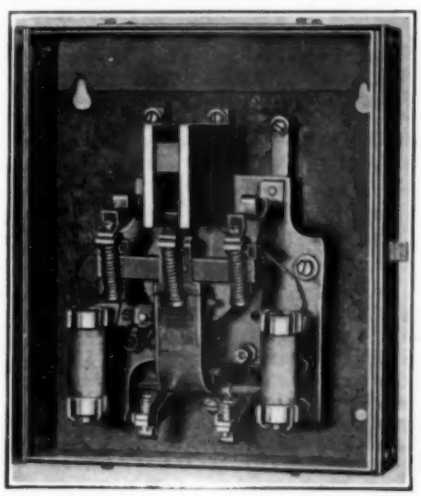
Perry Tilting Idler-Pulley Stand

also be lead over sideways in either direction, where desired, by tilting one of the two stands further than the other.

For narrow belts a single stand can be used and the pulley bracket can then be bridged over the upper end of the stand instead of between two stands as shown.

Westinghouse Across-the-Line Starters

The Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa., announces two across-the-line starters, the reversing and the non-reversing type, designed for easy accessibility. Two slotted hexagonal screws hold the starter unit in place in a sheet steel cabinet. The starter may be taken out as a unit by removing these two screws with an ordinary screw driver, leaving room



Westinghouse Across-the-Line Starters

inside the cabinet for attaching conduit bushings and drawing leads.

The starter consists of a 3-pole contactor with an electrical interlock. It is completely inclosed and is operated entirely from a push button station. In this way it provides safe control and eliminates damage which may be caused by tampering, or by unskilled handling. A floating armature-type, 3-pole contactor is used that provides smooth and positive contact. The contactors tips are kept clean by the rolling and wiping action in closing, thus reducing the common tendency to heat or weld when under load.

Where the operating conditions necessitate the protection of the starter against an accumulation of chips or other foreign matter, a door interlock may be had that makes it impossible to start the motor unless the cabinet door is fully closed.

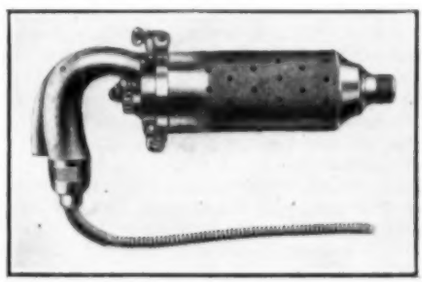
The non-reversing starters, class 11-160, are applicable for use in textile mills, on machine tools, woodworking machinery, conveyors, blowers, and pumps.

The reversing type, class 11-165, is of the same construction and has the same essential operating characteristics as the non-reversing type and, in addition, has a mechanical interlock which makes it impossible for both contactors to close at the same time.

"Simbi" Electrical Hammers

The "Simbi" electrical hammer is being placed upon the market by the Fermot Co., 200 Broadway, New York City. The hammer is operated by hand and resembles in size and shape a pneumatic hammer. This tool was originally designed for the use of sculptors and other stone workers, but the large sizes may readily be adapted to such work as calking pipes or plates, chipping, beading boiler tubes, drilling in stone or concrete, and many other operations of a similar nature.

The hammer operates on the electro-magnetic principle. An alternating current solenoid actuates a movable plunger whose recoil is governed by means of an adjustable helical spring. With 60-cycle current the frequency of percussion is 7,200 strokes per min. so that there



"Simbi" Electrical Hammer

is little noticeable vibration. Hence fatigue on the part of the operator is reduced to a minimum and often entirely eliminated under certain conditions.

The two commercial sizes are type C and D. Type C consumes 100 watts and weighs 7 lb. It can bore holes up to $\frac{5}{8}$ in. in diam. Type D consumes 200 watts and weighs 10 lb. It is suited for rougher work and can drill holes up to 1 in. in diam. in stone.

News of the Week

Scientists and Engineers Coming for Meeting of Electrotechnical Commission

United States committee will be host to foreign visitors

Leading scientists and engineers of America and Europe will attend a ten-day convention of the International Electrotechnical Commission, which will be held in the Engineering Societies Building, New York, beginning April 13. This meeting will be the first to be held in the United States by the commission, which functions through national committees representing the technical societies and governments of a score of nations.

Full quotas of delegates will be sent by every country represented on the commission, according to the announcement by Clayton H. Sharp, president of the United States national committee of the commission.

The commission, Mr. Sharp explains, is an international standardizing body in the electrical industry, and was organized in 1906 with Lord Kelvin as president following suggestions made at the Electrical Congress held in St. Louis in 1904. Not since the outbreak of the World War has the commission met with complete representation.

The delegation from Great Britain will be headed by Sir Richard Glazebrook, K. B. E.. president of the British national committee. These vice-presidents of the British committee will attend:

Sir Archibald Denny, Bart., chairman of the British Engineering Standards Association; L. B. Atkinson, W. W. Lackie, L. St. L. Pendred, editor of the *Engineer;* Col. F. T. Purves, C. P. Sparks, Sir George Sutton and W. B. Woodhouse.

Signor G. Semenza, president of the commission, will be among the Italian delegates. He will preside at the New York session. Others coming from Italy will include Signor E. Morelli, professor of electric machinery construction at the school of Engineering, Turin.

Germany will send leading industrialists and educators, among them Dr. P. Strecker, professor at Heidelberg and president of the German Electrotechnical Committee; Prof. M. Kloss, Charlottenberg; Dr. P. Schirp, secretary of the German Electrotechnical Committee; Prof. Rudenberg of Siemens-Schuckertwerke, and Dr. R. Stern.

From France will come J. J. Frick and E. Roth of the Societe Alsacienne. Belgium will be represented by a group including Frans Dupon and E. Uytborck.

Among the Holland delegates will be Prof. C. Feldmann, president of the Dutch Electrotechnical Committee; Bellaar Spruyt, chairman of the Electricity Supply Companies' Association.

From Switzerland will come the following: E. Huber-Stockar, president of the Swiss Electrotechnical Committee; A. Huber-Ruf, Charles Burlet, Antoine Schrafl, Paul Thut, and Dr. H. Zoelly.

Spain will be represented by Senor A. Artigas of the Ministry of Public Instruction; and Poland by M. C. Drewnowski of the Polytechnic School at Warsaw.

Norway has appointed H. A. Mork of Ekebergbanen, Oslo. Russia has informed the United States committee that it will designate two delegates one, of whom is Prof. Chatelain.

Co-operating with the committee in planning the session here are the War and Navy Departments, American Institute of Electrical Engineers, Electric Manufacturers Council, National Electric Light Association, American Society of Mechanical Engineers, American Society for Testing Materials, U. S. Bureau of Foreign and Domestic Commerce, U. S. Bureau of Standards and American Engineering Standards Committee.

At the close of the convention the delegates will tour the United States and Canada, being entertained by local committees in numerous cities, including Philadelphia, Washington, Pittsburgh, Chicago, Detroit, Niagara Falls, Ottawa, Montreal, Boston and Schenectady.

Would Simplify Gages for Wire and Sheet Metal

A preliminary conference to consider the desirability of simplifying the present wire and sheet-metal gage confusion, was held at the Engineering Societies Building, New York, on March 18 with a good representation from manufacturers and users present. C. E. Skinner, chairman of the A.E.S.C. presided.

The Division of Simplified Practice through W. Chattin Wetherill, chief of the metals division, offered the services of this division of the Department of Commerce in securing the co-operation of the various industries involved. He emphasized the fact that this division did not inaugurate changes, nor urge them, but that it simply helped in putting changes into practice when requested to do so by 80 per cent of those in each interested class.

A resume of present American practice in gages had been prepared by Col. E. C. Peck and was presented by John Gaillard of the A.E.S.C., showing that 26 gages were now in use in this country. Mr. Gaillard also gave a resume of European practice and presented correspondence from a number of well-known concerns favoring the abolition of gage numbers and the ordering of wires and sheets by decimal measurements.

It was decided that a sectional committee should be appointed to undertake the unification of the diverse systems now existing for gaging sheet metal and wire. A provisional committee, consisting of Messrs. White, Colvin, Fry, Wetherill and Lower was appointed to outline the work of such a committee and to suggest the technical societies to sponsor their work.

This committee met and reported at the same meeting, suggesting the A.S.M.E. and S.A.E. as sponsor societies and outlining the work of the sectional committee as dealing with the simplifying of the methods of gaging wire, sheets, plate and strip, and and the thickness of pipes or tubes of metal or metal alloys. Tolerances are also to be a part of the work of the committee.

L. P. Alford suggested that the committee carefully consider the desirability of the use of preferred numbers, either for gage numbers, should they be used, or for the sizes to be carried in stock. He pointed out the advantage of this method in securing uniformity in the increments between sizes and in lessening the numbers of sizes to be made and carried.

German Automotives Plan Reorganization

Negotiations are being conducted in Berlin between representatives of various German automobile firms looking to a reorganization of this industry in order to prepare for the production on a large scale of standardized type motor cars of about 8 or 9 horsepower.

It is stated that a number of well known German automobile factories and a large steel plant are interested in the project, which is said to have in view a joint construction bureau and the systematic distribution of work among factories.

In spite of the high duty on imported cars, the German automobile industry has been unable to hold its ground, and various forms of relief have been repeatedly suggested to aid the industry. A number of German economic writers and technical experts have recently expressed the view that it might prove profitable to raise the restrictions on low-priced foreign cars on condition that certain foreign countries agree not to export high-priced cars and trucks to Germany.

U. S. Furnished Third of British Machinery Imports in 1925

In 1925, the United Kingdom imported nearly $43,000,000 worth of industrial machinery, of which the United States furnished probably more than one-third. This huge volume of machinery imports is more than double the value absorbed in 1913, although the tonnage represents only 88 per cent of the pre-war imports. It is for the above reason that the United Kingdom is one of the most important markets for American machinery, but inasmuch as British machinery is perhaps our most serious competitor in other foreign markets, the fact that the United Kingdom absorbs such an important volume of American-made equipment is a testimonial to the high quality of American machinery.

It is somewhat surprising that the American participation in the British machinery trade has been so large during recent years, as Continental manufacturers have in many instances enjoyed the advantage of a declining exchange value for their currency. It is most encouraging to note that in spite of all these disturbed conditions American manufacturers have been able to maintain their position in this important trade.

The returns for the British imports for 1925 indicate an increase of 14 per cent in value and 21 per cent in tonnage when compared with 1924, and these figures, in turn, represent an increase of 12 per cent in value and 11 per cent in tonnage when compared with 1923.

During the past three years British imports of machine tools have shown a marked increase in total value, while the 1925 exports have returned to the 1923 total, with a declining value per ton. This is an item that may be of significance when one remembers the industrial conditions that have prevailed in England during these years. The imports there of machine tools in 1925 represented a gain of 39 per cent in value when compared with the previous year.

The price per ton of British machine tool imports in 1925 was £154, and in 1924, £165, as compared with a pre-war value of £97.

Propose Another Deputy to Secretary of War

A second assistant Secretary of War, to have immediate charge of aviation, is the principal proposal of the Senate Military Affairs Committee for increasing the efficiency of the Air Service. As the aviation branch is a combat organization, it is proposed that the name be changed to "Air Corps."

The committee endorses the idea that the corps have two additional assistant chiefs with the rank of Brigadier-General.

Officers on flying duty are to receive 50 per cent additional pay. Only a few Air Corps officers may be non-flyers. Temporary advancement in rank, not to exceed two grades, is allowed under certain conditions. Opportunity is given enlisted men to qualify as flyers and 20 per cent of flyers must come from the ranks. Compensation is provided for inventors and designers for unpatentable designs. New decorations for extraordinary heroism and achievements in peace time are provided. When one of these medals is awarded to an enlisted man it carries with it an increase in pay.

Chile Buys American Planes for Army

For the first time an American manufacturer of aeroplanes has been successful in securing a sizeable order from the Chilean army, reports the Department of Commerce. A contract has just been signed by an American manufacturer of aeroplanes to supply the Chilean government with 14 scout planes, 3 hangars and various accessories. In obtaining this order, the American firm competed against more than a dozen large European concerns and was successful despite the fact that prices were somewhat higher than those quoted by certain of the European manufacturers offering an article claimed to be as efficient.

Metal Trades Establish System of Interchange of Equipment

At the annual meeting of the Western Massachusetts branch of the National Metal Trades Association announcement was made of the institution of a service in the nature of an excess stocks and equipment exchange between members of the organization. If any factory finds itself overstocked in any line of machinery or equipment, or if it has more material on hand than seems desirable, it may dispose of these to other manufacturers.

Progress was reported for the newly established system of co-operative purchasing. Although it is not the purpose of the association to apply this plan to the purchasing of the major materials such as steel and copper, it will be utilized for the purchasing of various equipment, materials and supplies used in factory operations. Announcement was made that the decision to institute an indentured apprentice system had brought several hundred responses from young men.

On the conclusion of the business meeting the members were addressed by J. E. Nyhan, national secretary, of Chicago, speaking on association activities. Alexander Tulloch of Perth, Scotland, spoke on the British industrial situation.

These officers were elected: President, C. A. Mayer, American Bosch Magneto Corporation; vice-president, H. C. Beaver, Rolls-Royce of America, Inc.; treasurer, A. D. Scott, Hampden Brass Co. The executive committee consists of Charles P. Russell, John W. Russell & Sons Co.; John C. Beggs, Bemis & Call Co.; Robert E. Newcomb, Worthington Pump and Machinery Co.; T. K. O'Connor, G. Haarman, Inc.; C. E. Hazelton, John Russell Cutlery Co.; S. L. Butler, Northampton Cutlery Co.

Investigation Shows Need for Higher Tariff on Pig Iron

In connection with the application of the Eastern Association of Pig Iron Manufacturers for an increase in the duty on pig iron, the N. D. Tariff Commission has compiled a large amount of information bearing on the case. The data has been made available in a 52-page mimeographed report and the case set down for public hearing on April 20 in Washington.

The Tariff Commission's investigations find that high-grade pig iron from British India can be laid down at Philadelphia for $19.17 per long ton. The delivered cost at Philadelphia of Alabama iron is found to be $19.21; of iron from the Buffalo district, $24.59 and of iron from the Eastern district, $21.98.

The delivered cost of Eastern foundry and malleable iron at Philadelphia is $26.42 whereas Continental iron is laid down there for $19.38; United Kingdom iron for $22.18, and British India iron $20.01.

The 1924 total cost of production at domestic steel-works furnaces is calculated to have been $18.44 while total costs at merchant furnaces is shown as $23.52.

Water rates on foreign pig iron, the commission's investigators find, are so low as to give foreign producers an advantage on the Atlantic seaboard and even a greater advantage on the Gulf and Pacific coasts.

Imports are shown to be increasing rapidly, particularly from British India which produces a superior grade of pig iron and which has thoroughly modern plants. Forty-two per cent of the 1925 imports came from that country.

Since Canada quit buying pig iron in this country in 1921, exports have been small, averaging in 1923 and 1924 about one-tenth of one per cent of production. On the other hand imports have risen from 27,000 tons in 1921 to 441,425 tons in 1925.

With regard to foreign iron production the report says, in part:

"The principal foreign pig iron producing area is tributary to the Lorraine ore deposits and the Westphalia coal fields. Lorraine ore, which is high in phosphorus, produces pig irons that are undesirable for some purposes. European iron producing countries import large quantities of ore from Spain, Northern Africa, Sweden, and at times even from Brazil and Newfoundland.

"The iron industry of Great Britain is next in importance after that of the Ruhr-Lorraine section. Sweden has ample ore resources but no coal and produces only charcoal iron, which meets a special demand. India exports about 60 per cent of her production which was 550,000 tons in 1924 and is therefore an important factor in the international iron trade. There are large reserves of high-grade ore in India. There are ample supplies of coking coal and cheap labor. Modern blast furnace plants have been built. American consumers of pig iron, at times, are willing to pay a premium because of the high quality of Indian iron."

The Business Barometer

This week's outlook in Commerce, Finance, Agriculture and Industry based on current developments

By Theodore H. Price
Editor, *Commerce and Finance, New York*

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THE week's news is a conglomerate of the political and the economic. Seen in its true proportions the action of the League of Nations in refusing to admit Germany as a member is the most important happening since Locarno. Whether one be pro- or anti-League it must be admitted that the existence of the League has done much to repair and sustain European credit.

But it must also be admitted that the disintegration of the League would impair the confidence hitherto felt in the permanence of peace and the reconstruction of Europe. One immediate effect of the impasse that has arisen at Geneva is the decline in the value of the Belgian franc. It fell about half a cent last week, and while the drop may not have any direct bearing upon business in this country it is an adumbration of what may happen in the case of the smaller nations if they are deprived of the League's support and protection.

It is possible if indeed it is not probable, that this view of the facts may somewhat restrict the demand for European securities in the United States. If it does the effect may be an increase in our redundant credit supply, with more or less credit inflation as Europe sends us gold to pay her debts here and reimburse us for the goods she buys of us.

But of course she will prefer to pay us in merchandise when she can, and this preference is reflected in the excess of merchandise imports over exports reported for February. It amounts to $36,000,000, and with a similar excess of $15,000,000 in January makes a total adverse balance of $51,000,000 for the first two months of the calendar year.

This is a logical development and one that has been anticipated by the thoughtful, but of its psychological effect we cannot be certain. The country has been educated to believe that an excess of exports was "favorable" and the converse "unfavorable." Therefore it is questionable whether it can be taught that the reverse is the case now that we have become a creditor instead of a debtor nation.

There are, however, some indications that the public are coming to realize that we cannot sell unless we buy, and a few of the agricultural leaders are protesting against our tariff wall upon the ground that it limits the market for our exportable surplus of production. The question involved and prohibition promise to be the major political issues in the next election, as can be seen by anyone who has the patience to read the Congressional Record or to follow the proceedings of the Congressional Committee appointed to investigate the Tariff Commission and its disregarded recommendation that the duty on sugar should be reduced.

Another politico-economic question of importance to business men is the one that has been raised by the attempt to include in the McFadden bill a provision that would renew the Federal Reserve charters in perpetuity. This has excited no little resentment and may prejudice the ignorant and the reactionaries against renewing the Federal Reserve Charter at all.

If the opposition thus crystallized should be effective a calamity of the first magnitude would follow, and it is important that business men use their influence to avert a consummation so terrible to contemplate.

It may be thought that these things have no very direct relationship to the buying and selling of merchandise, and this is true. But they have been brought into the picture because they affect sentiment and have served to increase the uncertainty about the future that is now felt and was reflected in last week's markets.

There are now two schools of economic thought in the United States. One assumes that our prosperity is invulnerable because our wealth is so great. The other maintains that we cannot live unto ourselves alone and that as we produce more than we can use we must have a world market for the excess. As the maintenance of a world market depends upon the peace and progress of the world it is argued that anything that disturbs conditions abroad will ultimately be felt here and that we must keep on buying and lending if we hope to keep on selling and collecting. The wider acceptance of the latter view is a partial explanation for the week's hesitancy.

The stock market is lower. It now advances only when it is lifted. The speculation is forced and without spontaneity. The announcement that the Van Sweringens stood ready to release the securities deposited with them in support of the proposed Nickel Plate merger has led people to assume that the scheme has been abandoned.

This assumption seems to be without technical warrant, but it has been none the less depressing and the whole market has been under the shadow of a hope deferred.

The commodity markets have not, however, shared in this tendency, and most merchants seem to feel that a summer of good business is ahead.

Wheat and corn lack definite tendency. By threat and investigation the Government is rapidly killing speculation in grain. Rubber continues its gyrations on the rubber exchange, but the fluctuations do not seem to reflect any change in fundamental conditions.

Trade reports indicate a better demand for steel and other metals, but there may be some whistling to keep the wind up, for there is an undoubted curtailment in the amount of new construction planned.

Of course it is not to be expected that the greatest boom in the history of American stock speculation can be liquidated without causing some distress, but no serious consequences are expected and most merchants face the future with serenity.

What's Doing in Industry

The change for the better that was reported last week continues, with activity in the machinery industry showing decided signs of increasing. The end of this month, which closes the first quarter of 1926, is expected to reveal a very substantial business done. The record bids fair to exceed that of the same period last year.

Cincinnati reports increased activity on the part of buyers, small shops being good customers. Detroit sales have declined to normal, further expansions in automobile plants having been postponed for the present. A slight improvement in sales and inquiries in Indianapolis, and increased activity on the part of automotive and farm implement manufacturers in Chicago, pictures the Middle-West as being in fairly good shape.

The New England territory reports better business to the extent that manufacturers are encouraged to extend their working schedules in many cases. Buffalo reports the best business in several years, while New York is satisfied with the volume of small tool business that has developed. Large construction projects in Canada promise to afford good machinery business in the near future.

It is not to be expected that the greatest boom in the history of American stock speculation can be liquidated without causing some distress, but no serious consequences are anticipated and most business men face the future with serenity.

The Industrial Review

Progress of the machinery and machine-tool business in various parts of the country

THE following reports, gathered from the various machinery and machine tool centers of the country, indicate the trend of business in these industries and what may be expected from the future:

Cincinnati

In the past week the Cincinnati machine tool market did better than hold its own. Manufacturers and selling agents report increased activity among users and less hesitancy in buying. All regard the general situation as encouraging and the upward trend of business is expected to continue.

The greater part of the demand continues to be for replacements. An increased amount of buying by the smaller shops is regarded as an important development. There was considerable buying by industrial users and some purchases were made by the railroads.

With most concerns the feature of the past week's market was the sales to the automotive industries. Some export sales are reported, and the prospects in the foreign field are regarded as brighter.

The feeling among the local machine tool manufacturers and selling agencies is that trade conditions will continue to improve for some time to come. While all are proceeding in a careful, conservative way, this is not because of any apprehension, but merely as a necessary business precaution.

Detroit

Declining sales in the machinery and machine tool field in Detroit and southeastern Michigan are not causing any grave concern among representatives of machinery manufacturers. They point to the curve of sales for this period of the year during the past decade, and 1926 shows a close parallel to the average of the past ten years.

None of the automobile plants are showing any great signs of activity, although production remains at a uniformly high level. The year has started out to be another record-breaker in the total output of motor cars, but expansion programs are not of the immediate future, it appears.

The Packard Motor Car Co. is the only large concern that has bought any extensive order in the past few days. The two-and-a-half million dollar order for aircraft engines placed with Packard by the Navy Department is leading to a number of alterations in the experimental division at the Detroit plant.

Several other motor car manufacturers are buying toolroom equipment and filling in gaps all along the line. Calls for machines and tools have been quite varied, since the needs at different plants are not the same.

Paper manufacturers of the state are in the market for new machinery to care for the waste that is being dumped into Michigan's rivers and streams and polluting them.

The Wilson Foundry and Machine Co., of Pontiac, is buying some small tools needed for the production of six-thousand motors for the Federal Motor Truck Co.

Indianapolis

The last week showed a decided improvement in demand both for tools and machinery in Indianapolis. This comes as a welcome break to a somewhat desultory period since the first of the year. However, sales since Jan. 1 have been greater than they were for the same time last year. Weather conditions, which have been uniformly bad here, have had something to do with slowing up demand. It is noted that more customers are in the market than usual.

An active inquiry for contractors' equipment of all kinds, particularly equipment for road and bridge construction, is noted. Sales are being made in preparation for early spring work. The larger builders have also begun to make inquiries.

Automobile factories continue to be steady buyers, two local plants working steadily and other factories in Indiana making inquiries and reporting a good volume of business booked.

Demand for milling machinery is improving, mills in the northwest territory being active customers. The demand for printing machinery is good and inquiries are larger than they have been for months. Local factories also report a good demand for brick making machinery. Demand for used machinery is only fair but the number of inquiries are average and better business is expected.

Chicago

March, up to the present, has failed to produce the volume of business in machine tools and machinery that dealers had hoped for. Those whose stock comprises both used and new tools are in better shape to care for trade than those whose business is exclusively limited to only new tools.

While inquiries continue to be received in fairly satisfactory numbers, the closing of sales is comparatively slow. The principal demand still comes from the automotive and farm machinery industries, such railroads as have issued lists having given no hint of immediate closing. Chicago representatives of electrical and small tool manufacturers find business good in their lines, the demand in some localities being fully up to expectations.

As indicative of general optimism in the machinery trade it may be mentioned that at an auction sale of the entire equipment of the A. Nelson Manufacturing Co., makers of screw machine products, held last week, a larger representation of dealers than has been observed at any similar sale for months past was present. High prices were realized on most of the modern tools and many dealers in used machinery stocked up liberally.

New England

Builders of machinery in the New England section, encouraged by continued good volume of buying, are moved in some instances to make a slight gain in production schedules and to build for stock. This is especially true among the small tool manufacturers, who reason that this branch of the business has turned into its active cycle and that business will appear for prompt deliveries. The excess of surplus stock varies from 10 to 15 per cent of orders already on hand. Orders for small tools are now being received in considerable volume.

There is a good demand for automatics and turret machines; also for chucks and dies, especially in the foreign markets.

Employment in Bridgeport is increasing, a number of the plants now taking on mechanics as they apply.

Milwaukee

There is no complaint among manufacturers of metal-working equipment in this market concerning business conditions. If anything, the scarcity of desirable labor of a more or less highly skilled character, is of more concern than the volume of new business. Orders are developing in a fairly satisfactory manner, with sources more widely diversified.

The automobile industry is buying less equipment than a year ago at this time. Other shops are making replacements on a liberal scale.

Some equipment manufacturers have a moderate quantity of unfilled business that requires every effort to deliver according to specifications. In some cases shipments have been delayed as much as several weeks by the inability to cope with the situation because of the shortage of skilled machinists.

It is true that the automobile industry is now buying in greater moderation, but it would appear that if a decline should progress, it would be offset to a great extent by the requirements of other lines in the metal-working trades, which are now appearing as buyers in numbers that augur well for the situation during the next six to eight months.

Buffalo

This report reflects by far the best situation in the machine tool trade in Buffalo in quite a while. Business is becoming rapidly better. It is not too early to predict that the first quarter of the year will show a volume of business in this district better than the first quarter of 1925.

In some cases dealers have reported that their business for the first quarter will be double that of the same period last year, and one dealer stated that he would do as much business in this first quarter as in the entire year 1925.

Optimism prevails without exception. There is a large volume of buying in small orders from a wide variety of industrial sources. Inquiries continue to increase.

Railroad buying is practically nil for this city as is usual. The purchase of electrical equipment keeps pace with that of machinery.

The demand for contractors' equipment, which has been slow in the last few weeks, shows early evidences of reaching a good volume.

New York

Business in machinery and machine tools in this district has struck a more or less even trend. There has been no outstanding development in the past week, except perhaps the absence of large orders. Sales are about at normal for this time of the year, although they are frankly not up to the expectations of dealers.

Railroads have been in the market for some large pieces, and manufacturers of rolling stock for railroads have been asking for certain types of tools. Large industrials are buying cautiously, most orders being for single machines.

Small tools and miscellaneous shop equipment afford a bright spot in an otherwise colorless market. Sales have increased and the price situation in this field has become more favorable.

Sales in the past week included jig boring machines, large axle turning lathes, a 1,500-lb. steam hammer, spline millers, rotary surface grinders, gear tooth grinders and automatic milling machines.

Canada

The metal-working industry in Canada is generally well employed and there is every reason to believe that this condition will continue during the next two or three months at least. With big construction programs under way in many parts of the Dominion, especially in Ontario and Quebec, and with building operations scheduled to commence soon on several other large projects, there is bound to be sufficient orders forthcoming to keep all plants busy.

The rail mill of the Lake Superior Corporation at Sault Ste. Marie, Ontario, which has been closed all winter, will recommence operations the first of April. Plans for a big addition to the plant of the International Nickel Co., at Port Colborne, Ontario, at a cost of approximately $750,000, are being prepared. A third open-hearth furnace has been placed in operation by the Algoma Steel Corporation. Orders placed recently by the Canadian Pacific Ry. with car and locomotive builders have brought orders for billets, bars, etc.

The British Empire Steel Corporation has adjusted its rolls to the requirements of the New Zealand railways and is now engaged in rolling a 10,000-ton order for the Antipodes, which will keep the plant on single shift until the middle of April.

Hugh McGregor Died Last Week

Hugh R. McGregor, mechanical superintendent of the Brown & Sharpe Manufacturing Co. of Providence, R. I., for many years, died at his home in Edgewood, R. I., on March 17, following a long decline in health which only lately incapacitated him from work.

He was born in Brookville, Nova Scotia, in 1859, and came to Providence in 1871, his first employment being in connection with the manufacture of rifles at the Providence Tool Co. After six years with that company he became an apprenticed machinist with Brown & Sharpe, and before he had finished his period of apprenticeship be had become assistant foreman in connection with the building of milling machines. For the five years between 1893 and 1898, he was connected with the Curtis Electric Co., of Jersey City, and the Sprague Electric Co., of Bloomfield, N. J. Returning to his old connection in Providence in 1898, he became mechanical superintendent, holding this position with its large responsibilities until about a year ago.

Under his supervision was developed the present line of machine tools and accessories manufactured by Brown & Sharpe, many of them bearing the impress of his own ideas, especially in the line of milling machines. He was one of the oldest employees in point of service, covering a period of 44 years.

His work with the company in design and manufacture was most important. Among the members of the force he was known for his force of character, loyalty to his job and ability to turn out good work.

Opponents of Metric Bill Impress Committee

After listening to extended testimony from the opposition to the Britten Metric System Bill, a majority of the members of the House Committee on Coinage, Weights and Measures are prepared to vote against the reporting of the bill, it is believed.

At none other of the hearings which have been held on this subject has the opposition made such a strong case. It apparently has been established to the satisfaction of the majority of the committee that any change in such widely used units as those of weights and measures would result in enormous expense and inconvenience and would more than offset the great progress that has been made in the simplification program.

Work on Standardization of Washers and Pins

Separate preliminary meetings were held on March 19 in the rooms of the American Society of Mechanical Engineers, in New York, to consider the standardization of plain and lock washers and of straight, taper, split and dowell pins as manufactured for general use. R. S. Burnett of the S. A. E., C. B. LePage of the A. S. M. E., and F. J. Schlink of the A. E. S. C., outlined the proposed projects and the methods of procedure.

Lieutenant Victor E. Bentrandias, of McCook Field, representing the Army Air Service, was elected temporary chairman and H. A. Hoke, assistant mechanical engineer of the Pennsylvania R.R., as temporary secretary. Representatives of manufacturers of the Navy and of the Ordnance Department of the Army were present at the meeting on washers.

It was decided to appoint three subcommittees to consider the three phases of the washer problem. These are lock washers, punched washers and cast-iron and malleable washers. These subcommittees are to be announced later.

In the afternoon a similar group met to discuss the question of standard pins. The same society groups were present at this meeting as well as the Air Service and Ordnance Departments of the Army. It was tentatively decided to divide the work into two groups, with straight, taper and dowel pins in one, and spring cotters and split pins in another. The first is a machined product while the others are largely made by bending operations. It is planned to have further meetings in May and June.

Personals

GEORGE ENDICOTT has resigned as vice-president in charge of operations of the Wickwire Spencer Steel Co., of Worcester, Mass.

PAUL M. ATKINS has resigned from the faculty of the University of Chicago and has become associated with H. N. Stronck & Co., of Chicago, as a partner.

JAMES F. MILLER has resigned as president and general manager of the Interstate Foundries, Inc., of Cleveland. Mr. Miller is president of the Miller-Hurst Corporation, of Detroit.

CHARLES R. GRUETER, pioneer automobile designer, has joined the factory forces of the Stutz Motor Car Co. of America, and will be in charge of the production of the new Stutz vertical-eight engine.

RALPH MURPHY, formerly chief engineer and works manager, has been elected second vice-president of the H. H. Franklin Manufacturing Co., of Syracuse, builder of the Franklin motor car.

WILLIAM SULLIVAN, of Detroit, has been elected president of the Michigan Sheet Metal and Roofing Contractors' Association. Other officers are: Henry Rhodes, Grand Rapids, vice-president; and A. F. Martin, Saginaw, treasurer.

W. T. CLARK has been appointed factory manager of the J. W. Paxson Co., manufacturer of foundry equipment. Mr. Clark was at different times associated with the Otis Elevator Co., the General Electric Co. and the Fairbanks, Morse Co.

C. L. MCMULLEN, vice-president and general manager of the Fuller & Johnson Manufacturing Co., of Madison, Wis., manufacturer of automotive products, has been elected president of the company. He succeeds Walter Ayer, who recently resigned.

C. L. BAILEY has been appointed manager of the Toronto branch of William Jessop & Sons, Ltd., of Sheffield, England. Mr. Bailey succeeds his father, the late C. L. Bailey who was in charge of this office for several years.

HERBERT R. OWEN, formerly sales manager of hardware for Landers, Frary & Clark, New Britain, Conn., was elected vice-president of the company at the annual meeting on March 16. All other officers and directors of the company were re-elected.

GEORGE W. MASON, formerly general works manager of the Chrysler Corporation, has become identified with Copeland Products, Inc., as vice-president and general manager. Mr. Mason at different times was associated with the Studebaker Corporation, Dodge Brothers and the Maxwell Motor Corporation.

E. O. SHREVE, manager of the San Francisco office of the General Electric Co., since 1918, has been appointed manager of the industrial department of the company with headquarters at Schenectady, filling the vacancy caused by the recent death of A. R. Bush. Mr. Shreve joined the G. E. organization in 1904.

H. A. GARVEY has been appointed manager of the Packard Motor Car Co., body building division. Mr. Garvey succeeds E. H. Kotcher, who resigned. W. S. Bradt has been promoted to the position of superintendent of the stamping division. J. E. Doyle has been made foreman of the die-making department, and Oscar Findling has been promoted to the position of manager of the carriage division.

L. J. GALBREATH, until recently engaged in advertising and sales promotion activities for the Bridgeport Brass Co., has joined the American Brown Boveri Corporation to take charge of publicity and sales promotion for that company as assistant to Earl G. Hines, recently appointed general sales manager. Mr. Galbreath has served in executive and publicity capacities with Niles-Bement-Pond Co., New York and with the Columbia Machine Works and Malleable Iron Co., of Brooklyn.

Business Items

The Concrete and Steel Products Co. has leased the old Wellman-Seaver Morgan Co. plant at Akron, Ohio. The concern will begin production immediately.

The Dominion Tool and Forgings, Ltd., of Montreal, manufacturer of small tools, has established a plant at Sherbrooke, Quebec.

The Butcher & Gage Machine Shop, of Jackson, Mich., has been purchased by Donald M. Teer and J. S. Wickwire, of Jackson. They will operate under the name of Teer, Wickwire & Co.

The American Car and Foundry Co. has purchased the Shippers' Car Line Corporation, which was recently incorporated in New York to take over the stock of the American Welding Co.

At a recent meeting of the board of directors of the William Powell Co., Cincinnati, the following officers were elected: H. H. Coombe, president and treasurer; James Coombe, vice-president and general manager; Geo. E. Weitkamp, secretary.

It has been announced that the William Hamilton Co., Ltd., of Peterboro, Ontario, has been reorganized. The company will continue the manufacture of mining machinery, pulp and paper mill machinery, hydraulic turbines and saw mill equipment.

The Central Steel Co., of Massillon, Ohio, has opened a district sales office at 404 West First St., Tulsa, Oklahoma. This office will be in charge of L. S. Allen, who has a first-hand knowledge of steels through many years contact with the oil drilling industry.

The Wood Hydraulic Hoist and Body Co., of Indiana, has been incorporated at Indianapolis. The company will manufacture truck equipment for large tonnage trucks. The incorporators are Walter P. Pollard, William C. Richardson, Norman A. Perry and James A. Perry.

The Graton & Knight Manufacturing Co., of Worcester, Mass., is celebrating its "Diamond Jubilee," the company having been organized seventy-five years ago. Henry C. Graton, one of the original founders, and now 95 years old, is participating actively in the affairs of the company.

The Metal Mold Castings Co., Inc., of New York, has purchased the business of the Bronzo Alumina Corporation, of Buffalo, N. Y. On April first the latter organization will be dissolved and the business will be conducted thereafter at Buffalo by the former company. Theodore H. Pickering is president of the Metal Mold Company; J. E. Kaufmann is vice-president and chief engineer; and Eames Donaldson is secretary and treasurer.

Under the name of the Wallace Manufacturing Co., the Sussex Manufacturing Co., combined with the Wallace Machine Works, will resume operations in Sussex, New Brunswick. In 1919 W. H. Wallace formed the Wallace Machine Works, which

bought out the foundry and machine shop plant of the Sussex Manufacturing Co. The latter continued operations as a woodworking plant until last October, when it was shut down. Mr. Wallace will be president and manager of the new company.

The Boye & Emmes Co., of Cincinnati, well-known lathe manufacturer, has placed a contract for an entire new plant to replace the old one-story and basement structure which was destroyed by fire on Jan. 27. The Austin Co., of Cleveland, is the engineer and builder. The new plant will be 90x340 ft. of single-story monitor type construction. The center aisle will be served by a 10-ton traveling crane with 18 ft. under clearance. The owners have temporarily converted a building near to their property for turning out some emergency work.

Rolls-Royce of America, Inc., of Springfield, Mass., has taken over the automobile lamp equipment and organization of the Elliott Manufacturing and Plating Co., of that city and moved them to its East Springfield factory, where all lamps for the Rolls-Royce car will hereafter be made. The Elliott concern has been discontinued. Winfred C. Eastman, who was president and manager of the Elliott works, will superintendent the new department for Rolls-Royce.

The eleventh annual meeting of stockholders of the Air Reduction Co., Inc., was held last week. The following board of directors to serve for one year, was elected: Frederick S. Adams, chairman; Charles E. Adams, Frederic W. Allen, Matthew C. Brush, Robert K. Cassatt, Robert W. Goelet, A. R. Ludlow, Gates W. McGarrah, Robert C. Pruyn, Samuel F. Pryor, M. W. Randall, Percy A. Rockefeller, Paul Delorme, Edmond Deschars. At the organization meeting of the board all of the officers of the company were re-elected. They are Charles E. Adams, president; Herman Van Fleet, vice-president; Alden R. Ludlow first vice-president; Robert B. Davidson, secretary; Floyd J. Metzger, vice-president; Charles L. Snow, treasurer; Charles S. Munson, vice-president; Thomas G. Harrison, assistant secretary; Maurice W. Randall, vice-president; Richard W. Ryder, assistant treasurer.

Obituaries

GUSTAV F. C. HILLMANN, naval architect and designer of various types of marine equipment, died on March 15 at his home in Brooklyn, N. Y. He was a member of the American Society of Mechanical Engineers.

ALLEN CHAMBERS MCKINNIE, sales manager of the Stanley Works, New Britain, Conn., died at his home in New Britain on March 15. He began his business career with the Wyeth Hardware and Manufacturing Co., St. Joseph, Mo., and later went with the Simons Hardware Co. In 1897 he came to New Britain.

WILLIAM E. TENCH, Detroit, well-known railroad constructor and engineer, died on March 9. He was 68 years old. Mr. Tench's most notable engineering achievement was the building of the Niagara Falls Gorge Route Scenic R.R. about twenty years ago. He has been a consultant in almost all of the great engineering projects of the Michigan Central, the Pere Marquette, the Grand Trunk and the Lake Shore & Michigan Southern railroads.

JOHN W. CARLETON, general superintendent of the Union Manufacturing Co., of New Britain, Conn., died at his home in that city on March 6. Mr. Carleton had been employed in this capacity with the Union company for the past thirty-two years, and had served the company altogether nearly forty-six years. He was the designer of many of the lathe and planer chucks manufactured by the Union company.

ARTHUR HENDEY, one of the founders of the Hendey Machine Co., of Torrington, Conn., died on March 15 at Prescott, Ariz., after a prolonged illness. He was 80 years of age. Arthur Hendey was a patternmaker employed in New Haven in 1870 when his older brother, Henry J., suggested the partnership which was the nucleus of the business still bearing the family name. He had lived recently in the West because of his health. Burial was in Prescott, Ariz.

Pamphlets Received

"Oil Power." Published monthly by the Standard Oil Co. of New York, 26 Broadway, N. Y. The first issue of *Oil Power* has been published by this company. The periodical is to deal with the broader phase and the background of lubrication. The issue for February covers the history of lubrication, oil service and bearings and it has shorter articles on various factors within the field.

Why Schieren Belts Last Longer. The Chas. A. Schieren Co., 37 Ferry St., New York, N. Y., has issued pages 41 to 54, inclusive, of the series on Schieren belts. The section beginning with page 41 covers the care and the operation of belting. The points covered within the section are, the process for making endless belts, the use of dressings, methods of belt lacing and other factors in the handling of belting. The material included will be found very useful and well prepared. Many photographs have been included with the text, which are interesting and well-chosen.

Calendar of Local Meetings

National Association of Cost Accountants

Worcester. April 8. Cost of Cost Accounting and Its Value in Dollars.

Philadelphia. April 9. Business Mathematics, Sinking Funds and Depreciation. E. P. Moxey, Jr., speaker.

New York. April 13. Interpreting Statistics.

Albany. April 14. Preparation and Administration of the Budget.

Chicago. April 15. How to Introduce Scientific Planning in Industry.

Milwaukee. April 16. Brass Foundry Costs.

Mohawk Valley. April 19. Plant inspection visit to Rome, N. Y.

Twin Cities. April 20. A Cost System for a Small Manufacturer.

Hartford. April 20. Dinner meeting. Address by Durward Earle Burchell of Harvard University.

Los Angeles. April 20. Costs as a Factor in Management, E. R. Maule.

Pittsburgh. April 21. The Costs of Cost System Installation and Operation.

Rochester. April 21. The Application of Incentive Wage Plans.

Syracuse. April 21. Practical Psychology in Business.

Cleveland. April 21. Use of Mechanical Appliances.

Boston. April 22. Standard Costs and Variations, A. R. Davis.

Buffalo. April 22. Profit and Loss Statements.

Detroit. April 22. Material Costs Control.

American Society for Steel Treating

Hartford. June. Spring sectional meeting.

Society of Automotive Engineers

Detroit Section. March 25. Production meeting on automobile gearing.

Chicago. March 26. "Development and Trend in Industry," by F. E. Moskovics. Other discussions by H. L. Horning, and R. E. Wilson.

Northern California. March 26. "Gasoline and New Fuel Tests," by W. S. Jones.

American Society of Mechanical Engineers

Cincinnati. March 26. English Literary Club rooms. Subject: "Artificial and Natural Gas," by H. C. Blackwell.

Colorado. March 26. Metropole Hotel. Subject: "Reclamation Service," by W. C. Day.

St. Louis. March 26. Warwick Hotel. Subject: "Men and Methods," by Col. Fred C. Green.

St. Paul. March 26. St. Paul Auditorium. Speaker, J. E. Haynes, of the Government Museum, Yellowstone National Park.

New England Meeting. May 3 to 6. Providence, R. I. Chairman of program committee, Luther D. Burlingame.

Forthcoming Meetings

National Metal Trades Association. Twenty-eighth annual convention, Hotel Astor, New York, April 15 and 16. Secretary, J. E. Nyhan, Peoples Gas Bldg., Chicago, Ill.

American Welding Society. Annual meeting, Engineering Societies Bldg., New York City, April 21, 22 and 23.

National Foreign Trade Council. Thirteenth national foreign trade convention, Charleston, S. C., April 28, 29 and 30. O. K. Davis, secretary, India House, Hanover Square, New York.

American Gear Manufacturers' Association. Tenth annual meeting, Book-Cadillac Hotel, Detroit, May 13, 14 and 15. T. W. Owen, secretary, 2443 Prospect Ave., Cleveland, Ohio.

American Supply and Machinery Manufacturers' Association. Annual convention, Hotel Statler, St. Louis, week of May 17. F. D. Mitchell, secretary, 1819 Broadway, New York.

Society of Automotive Engineers. Summer meeting, French Lick Springs, Indiana, June 1 to 4. John Warner, manager of meetings, S. A. E., 29 West 29th St., New York City.

National Association of Purchasing Agents. Eleventh annual convention and exposition, Ambassador Hotel and Auditorium, Los Angeles, Calif., June 9 to 12. W. L. Chandler, secretary, Woolworth Bldg., New York.

American Railway Association. Annual meeting of the Mechanical Division (Master Car Builders and Master Mechanics), Atlantic City, N. J., June 9 to 16. V. R. Hawthorne, secretary, 431 So. Dearborn St., Chicago.

Railway Supply Manufacturers' Association. Annual convention and exhibit in conjunction with Division V, Mechanical, of the American Railway Association, Young's Million Dollar Pier, Atlantic City, June 9 to 16. J. D. Conway, secretary, 1841 Oliver Bldg., Pittsburgh.

Society of Industrial Engineers. Thirteenth national convention, Bellevue-Stratford Hotel, Philadelphia, June 16, 17 and 18. Executive secretary, George C. Dent, 608 S. Dearborn St., Chicago.

American Society for Testing Materials. Haddon Hall Hotel, Atlantic City, N. J., June 21 to 25. C. L. Warwick, secretary, 1315 Spruce St., Philadelphia.

American Society of Mechanical Engineers. Spring meeting, Palace Hotel, San Francisco, Calif., June 28 to July 1. Chairman of convention, Warren H. McBride, the California and Hawaiian Sugar Refining Co., 215 Market St., San Francisco.

American Railway Tool Foremen's Association. Annual convention, Hotel Sherman, Chicago, Sept. 1, 2 and 3. G. G. Macima, secretary, 11402 Calumet Ave., Chicago.

American Railway Tool Foremen's Supply Association. Annual exhibit in connection with the annual convention of the American Railway Tool Foremen's Association, Chicago, Sept. 1, 2 and 3.

American Foundrymen's Association. Second international foundrymen's congress, Detroit, Sept. 27 to Oct. 1, under the auspices of the American Foundrymen's Association. R. E. Kennedy, secretary, 909 W. California St., Urbana, Ill.

The Weekly Price Guide

Rise and Fall of the Market

Iron and Steel — Pig iron prices remain firm at present levels with active inquiry a feature of the market. Scrap tends upward. Finished steel holds steady with a tendency to advance in plates. Railway material, structurals, bars and pipe lead the market in demand. Black sheets are up 5c. per 100 lb., Pittsburgh. Floor plates dropped 30c. and galvanized sheets advanced 15c. per 100 lb. during week at New York warehouses. Mill prices remain unchanged at $2@$2.10 for bars; shapes, $1.90@$2; and plates, $1.80@$1.90 per 100 lb., Pittsburgh.

Non-Ferrous Materials—Copper is down ⅛c. and antimony 1c. per lb. compared with Mar. 13 level at New York warehouses; tin rose 1⅛c. per lb. Antimony and solder dropped ⅛c. per lb. in Cleveland during week.

(All prices as of Mar. 19)

IRON AND STEEL

PIG IRON—Per gross ton, f.o.b.:

CINCINNATI	
No. 2 Southern	$24.05
Northern Basic	24.27
Southern Ohio No. 2	24.27
NEW YORK—Tidewater Delivery	
Southern No. 2 (silicon 2.25@2.75)	28.37
BIRMINGHAM	
No. 2 Foundry	22.00
PHILADELPHIA	
Eastern Pa., No. 2x (silicon 2.25@2.75)	24.16
Virginia No. 2	29.17
Basic	23.16
CHICAGO	
No. 2 Foundry local	23.00
No. 2 Foundry, Southern (silicon 2.25@2.75)	26.55
PITTSBURGH, including freight charge ($1.76) from Valley	
No. 2 Foundry	22.27
Basic	22.27
Bessemer	22.27

IRON MACHINERY CASTINGS—Cost in cents per lb. of 100 flywheels, 6-in. face x 24-in. dia., hub not cored, good quality gray iron, weight 275 lb.:

Detroit	5.00@5.50
Cleveland	5.00@5.25
Cincinnati	5.00@5.50
New York	5.25@5.50
Chicago	5.25@5.75

SHEETS—Quotations are in cents per pound in various cities from warehouse; also the mill base in large lots.

Blue Annealed	Pittsburgh Mill Base	New York	Cleveland	Chicago
No. 10	2.45@2.50	3.89	3.25	3.50
No. 12	2.50@2.55	3.94	3.30	3.55
No. 14	2.55@2.60	3.99	3.35	3.60
No. 16	2.65@2.70	4.09	3.45	3.70
Black				
Nos. 18 to 20	3.05@3.15	4.30	3.90	3.90
Nos. 22 to 24	3.10@3.20	4.35	3.95	3.95
Nos. 26 and 27	3.15@3.25	4.40	4.00	4.00
No. 28	3.25@3.35	4.50	4.10	4.10
Galvanized				
No. 10	3.50@3.60	4.65	4.25	4.25
Nos. 12 to 14	3.60@3.70	4.75	4.35	4.35
No. 16	3.75@3.85	4.90	4.50	4.50
Nos. 18 to 20	3.90@4.00	5.05	4.65	4.65
Nos. 22 to 24	4.05@4.15	5.20	4.85	4.80
Nos. 26 and 27	4.20@4.30	5.35	5.10	4.95
No. 28	4.50@4.60	5.65	5.25	5.25

WELDED STEEL PIPE—Warehouse discounts are as follows:

	New York Black	New York Galv.	Cleveland Black	Cleveland Galv.	Chicago Black	Chicago Galv.
1 to 3 in. steel butt welded	53%	39%	55½%	43½%	54%	41%
2½ to 6 in. steel lap welded	48%	35%	53½%	40½%	51%	38%

Malleable fittings: Classes B and C, banded, from New York stock sell at list plus 4% less 5%. Cast iron, standard sizes, 36-5% off.

Size, Inches	List Price per Foot	Diameter in Inches — External	Diameter in Inches — Internal	Thickness Inches
1	$0.17	1.315	1.049	.133
1¼	.23	1.66	1.38	.14
1½	.27½	1.9	1.61	.145
2	.37	2.375	2.067	.154
2½	.58½	2.875	2.469	.203
3	.76½	3.5	3.068	.216
3½	.92	4.0	3.548	.226
4	1.09	4.5	4.026	.237
4½	1.27	5.0	4.506	.247
5	1.48	5.563	5.047	.258
6	1.92	6.625	6.065	.28

SEAMLESS STEEL TUBING—Following net prices are for seamless mechanical tubing, cold drawn, round, .10 to .30 carbon, at warehouse in lots of less than 100 ft.:

Thickness — Decimal	B.W.G. and Fractions	Outside Diameter in Inches — ½	⅝	¾	⅞	1	1⅛	1¼
		Price per Foot						
.035″	20	$0.15	$0.16	$0.17	$0.18	$0.19	$0.21	$0.23
.049″	18	.17	.18	.19	.20	.21	.23	.25
.065″	16	.19	.20	.21	.22	.23	.25	.27
.083″	14	.20	.22	.23	.24	.25	.27	.29
.095″	13	.21	.23	.25	.26	.27	.29	.31
.109″	12	.22	.24	.26	.27	.28	.30	.32
.120″ or .125″	11	.23	.25	.27	.28	.29	.31	.33
.134″	10	.24	.26	.28	.29	.30	.32	.34

MISCELLANEOUS—Warehouse prices in cents per pound in 100-lb. lots:

	New York	Cleveland	Chicago
Spring steel (light) (base)*	7.00	6.00@7.50	4.65†
Spring steel (heavier)	4.00	....	4.00
Coppered Bessemer rods (base)	6.05	6.00	6.20
Hoop steel	4.49	3.85	4.15
Cold rolled strip steel	6.25	6.35	6.25
Floor plates	5.25	5.60	5.50
Cold drawn shafting or screw	4.00	3.90	3.60
Cold drawn flats, squares	4.50	4.40	4.10
Structural shapes (base)	3.34	3.20	3.10
Soft steel bars (base)	3.24	3.10	3.00
Soft steel bar shapes (base)	3.24	3.11	3.10
Soft steel bands (base)	3.99	3.20	3.65
Tank plates (base)	3.34	3.40	3.10
Bar iron (3.00 at mill)	3.24	3.21	3.00
Drill rod (from list)	60@65%	55%	50%

Electric welding wire, New York, 3/32, 8.25c.; ⅛, 7.85c.; 5/32 to ¼, 7.35c. per lb. *Flat, 5/16@½-in. thick. †F.o.b. cars.

METALS

Current Prices in Cents Per Pound

Copper, electrolytic (up to carlots), New York			15.25
Tin, 5-ton lots, New York			67.00
Lead (up to carlots) E. St. Louis	8.00	New York	9.25
Zinc (up to carlots) E. St. Louis	7.50	New York	8.25

	New York	Cleveland	Chicago
Antimony (Chinese), ton spot	21.00	24.00	26.00
Copper sheets, base	22.75	22.75	22.75
Copper wire, base	19.50	16.50	16½@16¾
Copper bars, base	22.37½	22.37½	22.37½
Copper tubing, base	24.50	24.50	24.50
Brass sheets, base	19.12½	19.12½	19.12½
Brass tubing, base	23.75	23.75	23.25
Brass rods, base	16.87½	16.87½	16.87½
Brass wire, base	19.62½	19.62½	19.62½

Shop Materials and Supplies

METALS—Continued

	New York	Cleveland	Chicago
Aluminium ingots, 98 to 99%, 1 to 15 ton lots	27.00	27.00	27.02
Zinc sheets (casks)	12.00	12.60@12.95	12.27
Solder (½ and ½), (case lots)	40.25	40.50	38@42
Babbitt metal, delivered, New York, cents per lb.:			
Genuine, highest grade			81.50
Commercial genuine, intermediate grade			56.00
Anti-friction metal, general service			31.50
No. 4 babbitt (f.o.b.)			14.25
Nickel, f.o.b. refinery, cents per lb.:			
Ingots 31.00	Electrolytic 38.00	Shot	32.00

SPECIAL NICKEL AND ALLOYS—Price in cents per lb., f.o.b. Huntington, W. Va.:

Hot rolled nickel sheet (base)	52.00
Cold rolled nickel sheet (base)	60.00
Hot rolled rods, Grade "A" (base)	50.00
Cold drawn rods, Grade "A" (base)	58.00
Manganese nickel hot rolled rods "E"—low manganese (base)	54.00
Manganese nickel hot rolled rods "D"—high manganese (base)	57.00

Base price of Monel metal in cents per lb., f.o.b. Huntington, W. Va.:

Shot	32.00	Hot rolled rods (base)	40.00
Blocks	32.00	Cold drawn rods (base)	48.00
Ingots	38.00	Hot rolled sheets (base)	42.00
Cold rolled sheets (base)			50.00

OLD METALS—Dealers' purchasing prices in cents per pound:

	New York	Cleveland	Chicago
Crucible heavy copper	12.25@12.50	11.25	11.50@12.00
Copper, heavy, and wire	11.50@12.12½	11.50	11.00@11.50
Copper, light, and bottoms	10.00@10.37½	9.50	10.00@10.50
Heavy lead	7.50@7.75	7.50	7.25@7.75
Tea lead	5.00@5.50	5.00	6.25@6.75
Brass, heavy, yellow	7.50@7.75	7.25	7.75@8.25
Brass, heavy, red	9.50@10.00	9.50	8.75@9.25
Brass, light	6.25@6.50	6.00	7.25@7.75
No. 1 yellow rod turnings	8.50@9.00	8.00	7.75@8.25
Zinc	4.50@4.75	4.75	4.50@5.00

TIN PLATES—American Charcoal—Bright—Per box

		New York	Cleveland	Chicago
"AAA" Grade:				
IC,	14x20	$11.25	$11.45	$11.50
"A" Grade:				
IC,	14x20	8.85	9.40	9.50
Coke Plates—Primes—Per box				
100-lb.,	14x20	6.45	6.10	7.00
Terne Plates—Small lots, 8-lb. Coating—Per box				
IC,	14x20	7.85	6.95	7.50

MISCELLANEOUS

	New York	Cleveland	Chicago
Cotton waste, white, per lb.	$0.15@0.22	$0.19	$0.20
Cotton waste, colored, per lb.	.10@.15½	.10	.17
Wiping cloths, washed white, per lb	.18	36.00 per M	.16
Sal soda, per 100 lb. keg	2.15	2.25	2.75*
Roll sulphur, per 100 lb	2.60†	3.35	5.00
Linseed oil, per gal., 5 bbl. lots	.83½	.98	.85
Lard cutting oil, 25% lard, per gal.	.55	.50	.48
Machine lubricant, medium-bodied (55 gal. metal bbl.), per gal.	.35	.35	.29
Belting—Present discounts from list in fair quantities (½ doz. rolls).			
Leather—List price, 24c. per lin. ft. per inch of width for single ply.			
Medium grade	40–5%	40–5%	40–5%
Heavy grade	30–10%	30–10%	30–10%
Rubber transmission, 6-in., 6 ply, $1.83 per lin. ft.			
First grade	50%	50–10%	50%
Second grade	50–10%	60–5%	50–10%

*In 175 lb. kegs. † Per 150 lb. lot

Comparative Warehouse Prices

New York	Unit	Current Price	Four Weeks Ago	One Year Ago
Soft steel bars	per lb.	$0.0324	$0.0324	$0.0324
Cold drawn shafting	per lb.	.04	.04	.0415
Brass rods	per lb	.1687½	.1687½	.1712½
Solder (½ and ½)	per lb.	.4025	.3925	.40
Cotton waste	per lb.	.15@.22	.15@.22	15@22
Washers, cast iron (½ in.)	per 100 lb.	7.00	7.00	7.00
Emery, disks, cloth, No. 1, 6 in. dia.	per 100	3.55	3.55	3.38
Lard cutting oil	per gal.	.55	.55	.60
Machine oil	per gal.	.35	.35	.33
Belting, leather, medium	off list	40–5%	40–5%	40–2½%
Machine bolts up to 1x30 in.	off list	40%	40%	40%

MISCELLANEOUS—Continued

	New York	Cleveland	Chicago
Abrasive materials—In sheets 9x11 in., No. 1 grade, per ream of 480 sheets:			
Flint paper	$5.56	$5.84	$5.65
Emery paper	10.71	11.00	10.71
Emery cloth	29.48	31.12	29.48
Emery disks, 6 in. dia., No. 1 grade, per 100:			
Paper	1.49	1.45	1.49
Cloth	3.55	3.55	3.20
Fire clay, per 100 lb. bag		.60	.75
Coke, prompt furnace, Connellsville	per net ton		3.00@3.25
Coke, prompt foundry, Connellsville	per net ton		4.50@5.50
White lead, dry or in oil	100 lb. kegs	New York, 15.25	
Red lead, dry	100 lb. kegs	New York, 15.25	
Red lead, in oil	100 lb. kegs	New York, 16.75	

SHOP SUPPLIES

Machine bolts, ¼x1½-in., per 100, $1.70. Discount at New York warehouses on all sizes up to 1x30-in., 40%; 1¼ and 1¼x3-in. up to 12-in., 15%; with cold punched hex. nuts up to 1-in. dia. (plus std. extra of 10%) 30%; with hot pressed hex. nuts up to 1x30-in. (plus std. extra of 10%) 35%.

Carriage bolts, ¼x1½-in., per 100, $1.00. Discount on all sizes up to 1x30-in., 30%.

Coach and lag screws, 1½x$\frac{5}{16}$in., $2.25 per 100, less 40%.

Tap bolts, 1½x¼-in., $1.00 per 100. List plus 35% at New York warehouses.

Bolt ends, 1x12-in., 10c. per lb., less 40%.

Nuts, semi-finished, ¼x¼-in., 2c. each. Discount 70% for $\frac{5}{16}$-in and smaller and 65% for ⅜-in. and larger.
Case hardened ¼x¼-in., 6c. each, less 50%.

Rivets, button heads, ⅜-in., ½-in., 1-in. diam. x2$\frac{1}{16}$-in. to 4½-in. $5.00* per 100 lb. at New York warehouses; cone heads, same sizes, $5.20* per 100 lb. Rivets, $\frac{1}{16}$x1-in. and longer, 19c. per lb., less 50%. Same discount for tinned. EXTRA per 100 lb. for 1½ to 2-in. long, all diameters, 25c.; ⅜-in. dia., 35c.; ½-in. dia., 75c.; 1-in. long and shorter, 75c.; longer than 5-in., 50c.; less than 200 lb., 50c.; countersunk heads, 45c.

Washers, cast iron, ½-in., $7.00* per 100 lb. at New York warehouses: ⅜-in., $6.00* per 100 lb.

*For immediate delivery from warehouse.

Machine Requirements and Industrial Construction

Machine Tools and Equipment Wanted

Ala., Birmingham — McWane Gas Iron Pipe Co.—equipment for proposed 40 x 220 ft. addition to plant to be used for foundry. Estimated cost $100,000.

Conn., Bristol—Bd. of Education—machine and tool equipment for industrial arts department in high school.

Ill., Chicago—R. B. Hayward Co., 1700 Sheffield Ave.—one 10 ft. power groover.

Mass., Cambridge (Boston P. O.)—Bd. of Education—metal working machinery for Rindge Technical School.

Mich., Detroit—J. Watt, 7 Rosedale Ave. Greenfield universal grinder.

Mo., St. Louis—American Bed Co., 1413 South Eighteenth St.—Swain punch press No. 53.

N. Y., New York — Packard Motor Car Co., Broadway and 61st St.—equipment for proposed 3 story, 81 x 238 ft. ramp garage, sales and service building.

Wis., Milwaukee—E. B. Tonnsen Co., 113 Harmon St.—sheet metal working machinery for proposed 2 story, 86 x 88 ft. factory addition. Estimated cost $40,000.

Que., Cap-de-la-Madeleine—T. Iverson—machines for proposed plant for the manufacture of wire screen and mesh to be used in the paper industry. Estimated cost $50,000.

Que., Montreal—W. A. Crammond, 113 Dagenais St. (machinists)—drill press and shaper.

Que., Montreal — Cylinder Grinding & Auto Parts Co., 146 Mountain St.—complete tools and equipment including lathe, drill, etc.

Que., Montreal — Richard Electrical Works, 208 Plenis St., J. Richard, Purch. Agt.—screw cutting lathe.

Australia, Melbourne—Victorian Government Railways will receive bids until April 28 for one cylinder grinding machine including tools and accessories.

Opportunities for Future Business

Calif., Los Angeles—Bd. of Education, is having plans prepared for the construction of a 1 and 2 story, 60 x 140 and 60 x 160 ft. junior high school, (Luther Burbank), including 35 x 60 ft. shop and economics building. Estimated cost $375,000. Noerenberg & Johnson, 401 Los Angeles Railway Bldg., Archts.

Calif., Los Angeles—A. P. Mitchel, et al, c/o T. B. Keim, Haas Bldg., Archt., is having plans prepared for the construction of a 4 story, 104 x 155 ft. garage and service building at 12th and Figueroa Sts.

Calif., Vernon—American Can Co., is having plans prepared for the construction of a 2 story, 154 x 650 ft. addition to factory. Private plans.

Ill., Bloomington—Williams Oil-O-Matic Heating Corp., awarded contract for the design and construction of a 2 story building to The Austin Co., 16112 Euclid Ave., Cleveland, O. Estimated cost $100,000.

Ill., Chicago — Chicago Mfg. Co., 1462 South Michigan Ave., sheet metal manufacturers, awarded contract for the construction of a 1 story, 100 x 121 ft. factory. Estimated cost $36,000.

Ill., Chicago—G. Hoffman, 2921 East 79th Place, die manufacturers, awarded contract for the construction of a 1 story, 25 x 50 ft. factory at 3067 East 93rd St. Estimated cost $50,000.

Mass., Boston—Morgan's Furniture Co., 755 Washington St., plans the construction of a drying house and repair garage. Estimated cost $40,000 to $50,000. Architect not selected.

Mass., Boston—St. James Building Corp., St. James Ave., plans the construction of an 8 story garage at Park Square and St. James Ave. Architect not selected.

What This Section Is

Machinery Requirements and Industrial Construction is a reliable machinery market, because every item is reported first-hand by our own correspondents, scattered over the United States and Canada. These leads are verified by our men. We do not use newspaper clippings, nor do we listen to any hearsay or rumors. These sales leads are as accurate as our men can make them, and as timely as weekly publication will permit.

This market is for *American Machinist* subscribers. It covers the same machinery fields as does the paper. Here will be found inquiries for machine tools, presses, hammers, welding, forging and heat treating equipment, wood working machinery, cranes, hoists and other material handling machinery for the shop.

Here also will be found reports of proposed industrial construction, where sooner or later machinery will be needed.

Are you making the most of the opportunities listed here?

Mass., Brockton — M. Goodman, 25 Pleasant St., awarded contract for the construction of a 2 story, 80 x 240 ft. repair garage on Main St. Estimated cost $175,000.

Mass., Cambridge (Boston P. O.)—Cameron Ave. Garage, Inc., 40 Cottage St., Chelsea, will build a 1 story, 195 x 230 ft. repair garage and service station at 5-7 Cameron Ave., here. Estimated cost $100,000. S. E. Moffie, 51 Cornhill, Boston, Archt.

Mass., West Roxbury (Boston P. O.)—R. Cronin, 82 Spring St., awarded contract for the construction of a 1 story repair and service garage. Estimated cost $40,000. H. R. Duffee, 333 Belgrade Ave., Archt.

Mich., Muskegon — Shaw-Walker Co., manufacturers of office furniture, will receive bids until March 31 for the construction of a 5 story, 110 x 215 ft. factory. A. Kahn, 1000 Marquette Bldg., Detroit, Archt.

N. Y., Brooklyn—Kotten Machine Works, 59 Academy St., is having plans prepared for the construction of a 2 story, 80 x 100 ft. plant on 34th St. Estimated cost $50,000. H. J. Nurick, 44 Court St., Archt.

N. Y., Brooklyn—Pisciotta Bros. Inc., 426 Troutman St., manufacturers of plumbing specialties, plans the construction of a 4 story, 50x200 ft. plant. Estimated cost $130,000. Laspia & Samenfeld, 269 Broadway, Archts.

N. Y., Buffalo—Republic Metalware Co., 90 Alabama St., is having plans prepared for extensions to plant. Estimated cost $500,000. Hudson & Hudson, Dunn Bldg., Archts.

O., Canton — Haulk-Latherman Motors Co., 820 Tuscarawas St. E., will receive bids until March 30 for the construction of a 2 story, 96 x 200 ft. garage. Estimated cost $150,000.

O., Cincinnati — The Witt Cornice Co., 2118 Winchell St., awarded contract for the design and construction of a 1 story, 100 x 300 ft. galvanizing plant to The Austin Co., 16112 Euclid Ave., Cleveland.

O., Cleveland—The Otis Steel Co., L. C. Pratt, Purch. Agt., 3341 Jennings Road, plans the construction of a 1 story, 30x56 ft. addition to steel mill building. Estimated cost $40,000. W. F. Hilditch, 3341 Jennings Road, Engr.

O., Cleveland—The Republic Brass Co., J. Pollock, Secy., 1623 East 45th St., had plans prepared for the construction of a 1 story, 60 x 60 ft. addition to factory. Estimated cost $40,000. Christian, Schwarzenberg & Gaede, 1900 Euclid Bldg., Archts.

O., Cleveland—The Upson Walton Co., 1310 West 11th St., ship chandlers, awarded contract for the construction of a 1 story, 120x120 ft. machine shop and 60x120 ft. forge shop at 12500 Elmwood Ave. Estimated cost $75,000.

Pa., Beaver Falls—Standard Steel Specialty Co., awarded contract for the construction of a 1 story factory on Morado St. Estimated cost $50,000.

Pa., Philadelphia — Precision Grinding Wheel Co., Torsdale Ave., will build a 32 x 97 and 79 x 97 ft. addition to factory. Estimated cost $20,000. Private plans.

Pa., Philadelphia—L. J. Tonk, 303 Schaff Bldg., Archt., will receive bids until March 31 for the construction of a 4 story, 53 x 109 ft. garage at 60 North 4th St. for R. Rechbook.

R. I., Providence—City Hall Hardware Co., M. Seigel, 150 Washington St., had plans prepared for the construction of a 4 story factory at Snow and Washington Sts. Estimated cost $225,000. Private plans.

Tenn., Chattanooga — U. S. Cast Iron Pipe & Foundry Co., 71 Broadway, New York, N. Y., is having preliminary plans prepared for the construction of a plant here. Estimated cost $3,000,000. Private plans.

Tex., Port Arthur—Gulf Coast Machinery & Supply Co., R. M. Tyron, Mgr., 305 Orange St., plans the construction of a 1 story brass foundry and machine shop.

Wis., Milwaukee—A. B. &. B. Sheet Metal Works, 3300 Fond du Lac Ave., is having revised plans prepared for the construction of a 2 story, 36 x 130 ft. addition to factory. H. J. Esser, 82 Wisconsin St., Archt.

Wis., Oshkosh—Wilkin-Challoner Co., Nevada and Mt. Vernon Sts., awarded contract for the construction of a 1 story, 84 x 114 ft. foundry. Estimated cost $40,000.